PHILOSOPHICAL TRANSACTIONS,

OF THE

ROYAL SOCIETY

OF

LONDON.

VOL. LXX. For the Year 1780.

PART I.

LONDON,

SOLD BY LOCKYER DAVIS, AND PETER ELMSLY,
PRINTERS TO THE ROYAL SOCIETY.

MDCCLXXX.

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ADVERTISEMENT.

THE Committee appointed by the *Royal Society* to direct the publication of the *Philoſophical Tranſactions*, take this opportunity to acquaint the Public, that it fully appears, as well from the council-books and journals of the Society, as from repeated declarations, which have been made in ſeveral former *Tranſactions*, that the printing of them was always, from time to time, the ſingle act of the reſpective Secretaries, till the Forty-ſeventh Volume: the Society, as a body, never intereſting themſelves any further in their publication, than by occaſionally recommending the revival of them to ſome of their Secretaries, when, from the particular circumſtances of their affairs, the *Tranſactions* had happened for any length of time to be intermitted. And this ſeems principally to have been done with a view to ſatisfy the Public, that their uſual meetings were then continued for the improvement of knowledge, and benefit of mankind, the great ends of their firſt inſtitution by the Royal Charters, and which they have ever ſince ſteadily purſued.

But the Society being of late years greatly inlarged, and their communications more numerous, it was thought adviſeable, that a Committee of their members ſhould be appointed to reconſider the papers read before them, and ſelect out of them ſuch, as they ſhould judge moſt proper for publication in the future *Tranſactions*; which was accordingly done upon the 26th of March 1752. And the grounds of their choice are, and will continue to be, the importance and ſingularity of the ſubjects, or the advantageous manner of treating them; without pretending to anſwer for the certainty of the facts, or propriety of the reaſonings, contained in the ſeveral papers ſo publiſhed, which muſt ſtill reſt on the credit or judgment of their reſpective authors.

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It is likewiſe neceſſary on this occaſion to remark, that it is an eſtabliſhed rule of the Society, to which they will always adhere, never to give their opinion, as a body, upon any ſubject, either of Nature or Art, that comes before them. And therefore the thanks, which are frequently propoſed from the chair, to be given to the authors of ſuch papers, as are read at their accuſtomed meetings, or to the perſons through whoſe hands they receive them, are to be conſidered in no other light than as a matter of civility, in return for the reſpect ſhewn to the Society by thoſe communications. The like alſo is to be ſaid with regard to the ſeveral projects, inventions, and curioſities of various kinds, which are often exhibited to the Society; the authors whereof, or thoſe who exhibit them, frequently take the liberty to report, and even to certify in the public news-papers, that they have met with the higheſt applauſe and approbation. And therefore it is hoped, that no regard will hereafter be paid to ſuch reports, and public notices; which in ſome inſtances have been too lightly credited, to the diſhonour of the Society.

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PHILOSOPHICAL TRANSACTIONS.

I. *Calculations to determine at what Point in the Side of a Hill its Attraction will be the greateſt, &c.*

By Charles Hutton, *LL. D. and F. R. S.*
In a Letter to Nevil Maſkelyne, *D. D. F. R. S. and Aſtronomer Royal.*

Read Nov. 11, 1779.

DEAR SIR,

Royal Military Acad. Sept. 21, 1779.

AS the experiment of determining the univerſal attraction of matter, which you lately conducted with ſo much accuracy and ſucceſs, is of ſo great importance

portance and curiosity, that it may probably be hereafter repeated by the learned in other countries, and in other situations; and as the utmost precision is desirable in so nice an experiment; I have composed the inclosed paper to determine the best part of a hill for making the observations, so as to obtain the greatest quantity of attraction.

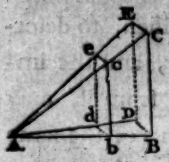
I have no doubt, Sir, that the determination of this point will appear of some consequence in the opinion of one who has the improvement of useful knowledge so much at heart; and if the manner in which it is here made, meet your approbation, I shall desire the favour of your presenting it to the Royal Society.

I have the honour to be, &c.

1. The

1. The great ſucceſs of the experiment, lately made by the Royal Society, on the hill Schehallien, to determine the univerſal attraction of matter, and the important conſequences that have reſulted from it, may probably give occaſion to other experiments of the ſame kind to be made elſewhere: and as all poſſible means of accuracy and facility are to be deſired in ſo delicate and laborious an undertaking; it has occurred to me that it might not be unuſeful to add, by way of ſupplement to my paper of calculations relative to the above-mentioned experiment, an inveſtigation of the height above the bottom of a hill, at which its horizontal attraction ſhall be the greateſt; ſince that is the height at which commonly the obſervations ought to be made, and ſince this beſt point of obſervation has never been any where determined that I know of, but has been variouſly ſpoken of or gueſſed at, it being ſometimes accounted at $\frac{1}{3}$, and ſometimes at $\frac{1}{2}$ of the height of the hill; whereas from theſe inveſtigations it is found to be generally at about only $\frac{1}{4}$ of the altitude from the bottom.

2. Let ABCEDA be part of a cuneus of matter, its ſides or faces being the two ſimilar right-angled triangles ABC, ADE meeting in the point A, and forming the indefinitely ſmall angle BAD. Then of any ſection



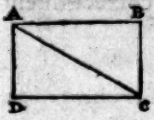
bced, perpendicular to the planes ABD and ADE, the attraction on a body at A in the direction AB, is equal to the conſtant quantity ss; where s = ſin. ∠BAC and s = ſin. ∠BAD, to the radius 1.

For, firſt, ſince the magnitude of the flowing ſection is every where as Ab^2, and the attraction of the particles of matter inverſely as the ſame, or as $\frac{1}{Ab^2}$; therefore their product or $\frac{Ab^2}{Ab^2}$ or 1 (a conſtant quantity) is as the force of attraction of bced.

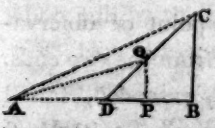
Then to find what that quantity is. Put AB = a, and BC = x; then BD or CE (the diſtance between the two planes at the diſtance AB) is = as. Now the force of a particle in the line CE is as $\frac{1}{AC^2}$ in the direction AC, and therefore it is as $\frac{AB}{AC^3}$ in the direction AB; conſequently the force of the whole lineola CE in the direction AB is $\frac{AB.CE}{AC^3}$; and therefore the fluxion of the force of the ſection BCED or $\dot{f}$ is = $\frac{AB.CE}{AC^3} . B\dot{C} = \frac{a.as.\dot{x}}{\overline{a^2+x^2}|^{\frac{3}{2}}} = \frac{a^2s\dot{x}}{\overline{a^2+x^2}|^{\frac{3}{2}}}$; and the fluent gives $f = \frac{sx}{\sqrt{a^2+x^2}} = s \times \frac{BC}{AC} = ss$ for the attraction itſelf.

3. To

3. To find now the attraction of the whole right-angled cuneus on a body at A in the direction AB.—Since the force of each section is ss by the last article, therefore the force of all the sections, the number of them being AB or a, is $ass = s$. AB. $\frac{BC}{AC}$ the force of the whole cuneus ABCEDA.



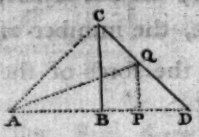
4. To find the attraction of the rectangular part ABCD on A in the direction AB; ABCD being one side of the cuneus, and AD its edge.—Put AD = BC = b, and AB = x. Then, the force of any section as BC being always as ss by Art. 2, the fluxion of the force or $\dot{f}$ will be $= ss\dot{x} = s\dot{x} \times \frac{BC}{AC} = s\dot{x} \times \frac{b}{\sqrt{b^2+x^2}} = \frac{bs\dot{x}}{\sqrt{b^2+x^2}}$; and the fluent is $f = bs \times$ hyp. log. of $\frac{x+\sqrt{b^2+x^2}}{b} = s$. BC $\times$ hyp. log. $\frac{AB+AC}{BC}$ = the attraction of ABCD.



5. To find the attraction of the right-angled part BCD of a cuneus whose edge passes through A the place of the body attracted.—Put AB = a, BC = b, BD = c, DA = $d = a - c$, DC = e, AC = g, and DP = x. Then, the force of any section PQ being still as ss, the fluxion of the force of the part DPQ is $\dot{f} = ss\dot{x} = s\dot{x} \times \frac{PQ}{AQ} = \frac{bsx\dot{x}}{\sqrt{c^2d^2+2c^2dx+e^2x^2}}$; and the correct fluent

when

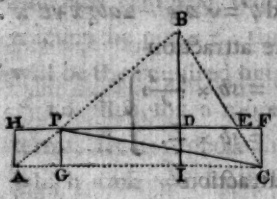
when $x = c$ is $f = \frac{bcs}{ee} \times g - d - \frac{dc}{e} \times$ hyp. log. $\frac{ee + eg + dc}{de + dc}$ = the force of a body at A in the direction AB.



6. To find the attraction of the right-angled part BCD on the point A. — Uſing here again the ſame notation as in the laſt article, we have $\dot{f} = s\dot{s}\dot{x} = s\dot{x} \times \frac{PQ}{AQ} = \frac{bs\dot{x}\dot{x}}{\sqrt{c^2d^2 - 2c^2dx + c^2x^2}}$. The correct fluent of which, when $x = c$, is $f = \frac{bcs}{ee} \times g - d + \frac{dc}{e} \times$ hyp. log. $\frac{ee + eg - dc}{de - dc}$.

7. To apply now theſe premiſes to the finding of the place where the attraction of a hill is greateſt, it will be neceſſary to ſuppoſe the hill to have ſome certain figure. That poſition is moſt convenient for obſerving the attraction, in which the hill is moſt extended in the eaſt and weſt direction. Suppoſing then ſuch a poſition of a hill, and that it is alſo of a uniform height and meridional ſection throughout; the point of obſervation muſt evidently be equally diſtant from the two ends. But inſtead of being only conſiderably extended, I ſhall ſuppoſe the hill to be indefinitely extended to the eaſt and to the weſt of the point of obſervation, in order that the inveſtigation may be mathematically true, and yet at the ſame time ſufficiently exact for the beforeſaid limited extent alſo. It will alſo come neareſt to the

practical experiment, to ſuppoſe the hill to be a long triangular priſm, ſo that all its meridional ſections may be ſimilar triangles. Let therefore the triangle ABC repreſent its ſection by a vertical plane paſſing through the meridian, or one ſide of an indefinitely thin cuneus whoſe edge is in PG; or rather PBCGP the ſide of one cuneus, and PAG the ſide of another, their common edge being the line PG perpendicular to the baſe AC; P being the required point in the ſide AB where the attraction of the ſection ABC, or indefinitely thin cuneus, ſhall be greateſt in a direction parallel to the horizon AC. And then from the foregoing ſuppoſitions, it is evident that in whatever point of AB the attraction of ABC is greateſt, there alſo will the attraction of the whole hill be the greateſt.



8. Now draw HPDEF parallel to AC; and AH, PG, BI, CF, perpendicular to the ſame. Then it is evident that at the point P, in the direction PF, the attraction of PBCGP is affirmative, and that of PAG negative. But PBCGP is = PBD + BDE + PFCG − EFC; and PAG = PHAG − PHA. Therefore the attractions of PBD, BDE, PFCG, PHA, are affirmative; and thoſe of EFC, PHAG, negative.

Put

Put now BI $= a$, AI $= b$, IC $= c$, AB $= d$, BC $= e$, AC $= g = b + c$, and PG $= x$, the altitude of the point P above the bottom. Alſo let s = the ſine of the indefinitely ſmall angle of the cuneus to rad. 1; and $q = \sqrt{a^2g^2 - 2abgx + d^2x^2}$.

Then by Art. 3, the attraction

of $\begin{cases} \text{PBD is } s \cdot \text{PD} \cdot \frac{\text{BD}}{\text{BP}} = sb \times \frac{a-x}{d}, \\ \text{PHA is } s \cdot \text{PH} \cdot \frac{\text{PG}}{\text{PA}} = sb \times \frac{x}{d}. \end{cases}$

By Art. 4, the attraction

of $\begin{cases} \text{PFCG is } s \cdot \text{PG} \times \text{h. l.} \frac{\text{PF}+\text{PC}}{\text{PG}} = sx \times \text{h. l.} \frac{ag - bx + qq}{ax}, \\ \text{PGAH is } s \cdot \text{PG} \times \text{h. l.} \frac{\text{PH}+\text{PA}}{\text{PG}} = sx \times \text{h. l.} \frac{b+d}{a}. \end{cases}$

By Art. 5, the attraction of EFC is

$$s \cdot \frac{\text{EF} \cdot \text{FC}}{\text{EC}^2} \times \text{PC} - \text{PE} - \frac{\text{PE} \cdot \text{EF}}{\text{EC}} \times \text{h. l.} \frac{\text{EC}^2 + \text{EC} \cdot \text{PC} + \text{PE} \cdot \text{EF}}{\text{PE} \cdot \text{EC} + \text{PE} \cdot \text{EF}}$$

$$= \frac{ae}{a} \times qq - g \cdot \overline{a-x} - gc \cdot \frac{a-x}{c} \times \text{h. l.} \frac{acg + cqq + aax - bcx}{g \cdot c + c \cdot a - x}.$$

Laſtly by Art. 6, the attraction of BDE is

$$s \cdot \frac{\text{BD} \cdot \text{DE}}{\text{BE}^2} \times \text{PB} - \text{PE} + \frac{\text{PE} \cdot \text{DE}}{\text{BE}} \times \text{h. l.} \frac{\text{BE}^2 + \text{BE} \cdot \text{BP} - \text{PE} \cdot \text{DE}}{\text{PE} \cdot \text{BE} - \text{PE} \cdot \text{DE}}$$

$$= \frac{ae}{a} \cdot \overline{a-x} \times \overline{d-g} + \frac{cg}{c} \times \text{h. l.} \frac{ec + de - cg}{cg - cg}.$$

Theſe quantities being collected together with their proper ſigns, and contracted, we have

$$s \times \begin{cases} \frac{ab}{d} + C \cdot \frac{ad - qq - dx}{ae} + x \times \text{hyp. log.} \frac{ag + qq - bx}{b+d \cdot x} + \\ \frac{cg \cdot a-x}{c} \times \text{h. l.} \frac{ae + de - cg \cdot ag + cqq + a^2x - bcx}{gg \cdot ae - cc \cdot a-x} \end{cases}$$

for the whole attraction in the direction PE.

9. Having now obtained a general formula for the meaſure of the attraction in any ſort of triangle, if the particular values of the letters be ſubſtituted which any practical caſe may require, and the fluxion of this attraction be put = o, the root of the reſulting equation will be the required height from the bottom of the hill.

10. But for a more particular ſolution in ſimpler terms, let us ſuppoſe the triangle ABC to be iſoſceles, in which caſe we ſhall have $d = e$, and $g = 2b = 2c$, and then the above general formula will become

$$s \times \left\{ \begin{array}{l} \frac{2ad - gq - dx}{dd} b + x \times \text{h. l. } \frac{2ab + gq - bx}{b + d \cdot x} \\ + \frac{a - x}{d^3} \cdot 2b^3 \times \text{h. l. } \frac{2ab^3 + dq^3 - b^3 - a^3 \cdot x}{2b^3 \cdot a - x} \end{array} \right\}$$

for the value of the attraction in the caſe of the iſoſceles triangle, where q^3 is $= \sqrt{4a^2b^2 - 4ab^2x + d^2x^2}$. And the fluxion of this expreſſion being equated to o, the equation will give the relation between a and x for any values of b and d, by a proceſs not very troubleſome.

11. Now it is probable that the relation between a and x, when the attraction is greateſt, will vary with the various relations between b and d, or between b and a. Let us therefore find the limits of that relation, between which it may always be taken, by uſing two particular extreme caſes, the one in which the hill is

very ſteep, and the other in which it is very flat, or a very ſmall in reſpect of b or d.

12. And firſt let us ſuppoſe the triangular ſection to be equilateral; in which caſe the angle of elevation is 60°, which being a degree of ſteepneſs that can ſcarcely ever happen, this may be accounted the firſt extreme caſe. Here then we ſhall have $d = 2b = \frac{2}{3}a\sqrt{3}$, and the formula in Art. 10, will become $s \times : \frac{2a-r-x}{3} + x \times$ h. l. $\frac{2a+2r-x}{3x} + \frac{a-x}{4} \times$ h. l. $\frac{a+2r+x}{a-x}$ for the value of the attraction in the caſe of the equilateral triangle, in which r is $= \sqrt{a^2 - ax + x^2}$.

13. Or if we take $x = na$, where n expreſſes what part of a is denoted by x, the laſt formula will become $sa \times : 1 - \frac{1}{2}n - \frac{1}{2}\sqrt{1-n+n^2} + n \times$ h. l. $\frac{2-n+2\sqrt{1-n+n^2}}{3n} + \frac{1-n}{4} \times$ h. l. $\frac{1+n+2\sqrt{1-n+n^2}}{1-n}$ for the caſe of the equilateral triangle.

14. To find the maximum of the expreſſion in the laſt article, put its fluxion = o, and there will reſult this equation $1 + \frac{1+n}{\sqrt{1-n+n^2}} = 2$ h. l. $\frac{2-n+2\sqrt{1-n+n^2}}{3n} - \frac{1}{2}$ h. l. $\frac{1+n+2\sqrt{1-n+n^2}}{1-n}$; the root of which is $n = .251999$. Which ſhews that, in the equilateral triangle, the height from the bottom to the point of greateſt attraction, is only

only $\frac{1}{300}$th part more than $\frac{1}{4}$ of the whole altitude of the triangle. And this is the limit for the ſteepeſt kind of hills.

15. Let us find now the particular values of the meaſure of attraction ariſing by taking certain values of n varying by ſome ſmall difference, in order to diſcover what part of the greateſt attraction is wanting by obſerving at different altitudes.

16. And firſt uſing the value of n (·251999) as found in the 14th article, the general formula in Art. 13, gives $sa \times 1{\cdot}0763700$ for the meaſure of the greateſt attraction.

17. If $n = \frac{3}{10}$, or $x = \frac{3}{10}a$; the ſame formula gives $\frac{sa}{20} \times : 17 - \sqrt{79} + 6\text{h. l. } \frac{17 + 2\sqrt{79}}{9} + \frac{7}{2}\text{h. l. } \frac{13 + 2\sqrt{79}}{7} = sa \times 1{\cdot}0702512$ for the attraction at $\frac{3}{10}$ of the altitude, which is ſomething leſs than the other.

18. If $n = \frac{4}{10} = \frac{2}{5}$; the formula gives $\frac{sa}{20} \times : 16 - \sqrt{76} + 8\text{h. l. } \frac{8 + \sqrt{76}}{6} + 3\text{h. l. } \frac{7 + \sqrt{76}}{5} = sa \times 1{\cdot}0224232$ for the attraction at $\frac{4}{10}$ or $\frac{2}{5}$ of the altitude; leſs again than the laſt was.

19. If $n = \frac{5}{10} = \frac{1}{2}$; the formula gives $\frac{1}{4}sa \times : 3 - \sqrt{3} - 2\text{h. l. } 3 + \frac{5}{4}\text{h. l. } \overline{3 + 2\sqrt{3}} = sa \times {\cdot}9340963$ for the attraction at half way up the hill; ſtill leſs again than the laſt.

20. If $n = \frac{6}{10} = \frac{3}{5}$; the formula gives $\frac{sa}{20} \times : 14 - \sqrt{76} + 12 \text{ h. l. } \frac{7+\sqrt{76}}{9} + 2 \text{ h. l. } \frac{8+\sqrt{76}}{2} = sa \times .8109843$ for the attraction at $\frac{6}{10}$ or $\frac{3}{5}$ of the altitude from the bottom; being ſtill leſs than the laſt was. And thus the quantity of attraction is continually leſs and leſs the higher we aſcend up the hill above the .251999 part, or in round numbers .252 part of the altitude. Let us now deſcend, by trying the numbers below .252; and firſt,

21. If $n = .25 = \frac{1}{4}$; the ſame formula in Art. 13, gives $\frac{1}{8} sa \times : 7 - \sqrt{13} + 2 \text{ h. l. } \frac{7+2\sqrt{13}}{3} + \frac{3}{2} \text{ h. l. } \frac{5+2\sqrt{13}}{3} = sa \times 1.0763589$ for the attraction at $\frac{1}{4}$ of the altitude; and is very little leſs than the maximum.

22. If $n = \frac{2}{10} = \frac{1}{5}$; the formula gives $\frac{1}{10} sa \times : 9 - \sqrt{21} + 2 \text{ h. l. } \frac{9+2\sqrt{21}}{3} + 2 \text{ h. l. } \frac{3+\sqrt{21}}{2} = \frac{1}{10} sa \times : 9 - \sqrt{21} + 2 \text{ h. l. } \frac{23+5\sqrt{21}}{2} = sa \times 1.0684622$ for the attraction at $\frac{2}{10}$ or $\frac{1}{5}$ of the altitude; and is ſomething leſs than at $\frac{1}{4}$ of the altitude.

23. If $n = \frac{1}{10}$; the formula gives $\frac{sa}{20} \times : 19 - \sqrt{91} + 2 \text{ h. l. } \frac{19+2\sqrt{91}}{3} + \frac{9}{2} \text{ h. l. } \frac{11+2\sqrt{91}}{9} = sa \times .9986188$ for the attraction at $\frac{1}{10}$ of the altitude; ſtill leſs than the laſt was. And, laſtly,

24. If $n = 0$, or the point be at the bottom of the hill;

hill; the formula gives $\frac{1}{4}sa \times \overline{2 + \text{h. l. } 3} = sa \times .7746531$ for the attraction at the bottom of the hill; which is between $\frac{1}{3}$ and $\frac{2}{4}$ of the greateſt attraction, being ſomething greater than $\frac{2}{3}$ but leſs than $\frac{3}{4}$ of it.

25. The annexed table exhibits a ſummary of the calculations made in the preceding articles; where the firſt column ſhews at what part of the altitude of the hill the obſervation is made; the ſecond column contains the correſponding numbers which are proportional to the attraction; and the third column ſhews what part of the greateſt attraction is loſt at each reſpective place of obſervation, or how much each is leſs than the greateſt.

$\frac{6}{10}$	8109843	$\frac{1}{4}$
$\frac{5}{10}$	9340963	$\frac{2}{11}$
$\frac{4}{10}$	10224232	$\frac{1}{10}$
$\frac{3}{10}$	10792512	$\frac{1}{110}$
$\frac{252}{1000}$	10763700	0
$\frac{1}{4}$	10763589	$\frac{1}{37111}$
$\frac{2}{10}$	10684622	$\frac{1}{133}$
$\frac{1}{10}$	9986188	$\frac{1}{14}$
0	7746531	$\frac{2}{7}$

26. Having now ſo fully illuſtrated the caſe of the firſt extreme, or limit, let us ſearch what is the limit for the other extreme, that is, when the hill is very low or flat. In this caſe b is nearly equal to d, and they are both very great in reſpect of a; conſequently the formula for the attraction in Art. 10, will become barely $s \times : x \times \text{h. l. } \frac{2a-x}{x} + 2 \cdot \overline{a-x} \times \text{h. l. } \frac{2a-x}{a-x}$; the fluxion of which being put $= 0$, we obtain $0 = \text{h. l. } \frac{2a-x}{x} - 2\,\text{h. l. } \frac{2a-x}{a-x} = \text{h. l. } \frac{2a-x}{x} - \text{h. l. } \overline{\frac{2a-x}{a-x}}^2 = \text{h. l. } \frac{\overline{a-x}^2}{x \cdot 2a-x}$; hence therefore $\overline{a-x}^2 = x \cdot \overline{2a-x}$, and $x = a \times 1 - \sqrt{\frac{1}{2}} = .2929a$.

·2929*a*. Which ſhews that the other limit is $\frac{29}{100}$; that is, when the hill is extremely low, the point of greateſt attraction is at $\frac{29}{100}$ of the altitude, like as it is at $\frac{25}{100}$ when the hill is very ſteep. And between theſe limits it is always found, it being nearer to the one or the other of them, as the hill is flatter or ſteeper.

27. Thus then we find that at $\frac{1}{4}$ of the altitude, or very little more, is the beſt place for obſervation, to have the greateſt attraction from a hill in the form of a triangular priſm of an indefinite length. But when its length is limited, the point of greateſt attraction will deſcend a little lower; and the ſhorter the hill is, the lower will that point deſcend. For the ſame reaſon, all pyramidal hills have their place of greateſt attraction a little below that above determined. But if the hill have a conſiderable ſpace flat at the top, after the manner of a fruſtum, then the ſaid point will be a little higher than as above found. Commonly, however, $\frac{1}{4}$ of the altitude may be uſed for the beſt place of obſervation, as the point of greateſt attraction will ſeldom differ ſenſibly from that place. And when uncommon circumſtances may produce a difference too great to be intirely neglected, the obſerver muſt exerciſe his judgment in gueſſing at the neceſſary change he ought to make in the place of obſervation, ſo as to obtain the beſt effect which the concomitant circumſtances will admit of.

II. *An Account of ſome new Experiments in Electricity, with the Deſcription and Uſe of two new Electrical Inſtruments.* *By Mr.* Tiberius Cavallo, *F. R. S. communicated by the Preſident.*

Read Nov. 25, 1779.

PROFESSOR LICHTENBERG, of Gottingen, ſome time ago made an experiment upon the electrophorus, an account of which was firſt received in London towards the latter end of the year 1777. The phenomena attending the experiment are very entertaining and various, but I do not know that any perſon ever offered a ſatisfactory explanation of them. The author himſelf, in his paper entitled "*De nova methodo naturam ac motum Fluidi Electrici inveſtigandi Commentatio prior*," wherein he gives an account of the experiment, does not attempt any explanation of it; contenting himſelf with the account only of various particulars attending it. In brief, the experiment is as follows:

The electrophorus, that is, a plate of ſome reſinous ſubſtance, as ſulphur, roſen, gum-lac, &c. is firſt excited, either by rubbing, or otherwiſe; then a piece of metal of any ſhape at pleaſure, as, for inſtance, a three-legged compaſs, a piece of braſs tube, or the like, is ſet upon the electrophorus; and to this piece of metal, ſo placed, a ſpark is given of the electricity contrary to that of the plate. This done, the piece of metal is removed by means of a ſtick of ſealing-wax, or other electric; and ſome powder of roſen, kept in a linen bag, is ſhaken upon the electrophorus. This powder will be found to fall about thoſe points upon the plate which the piece of metal touched, forming ſome radiated appearances much like the common repreſentations of ſtars; at the ſame time upon the greateſt part of the plate, that is, in all parts except where the ſtars are formed, there is hardly any powder at all. Now it is to be remarked, that if the plate be excited negatively, and the ſpark given to the metal ſet upon it, be poſitive, the appearance will be as above deſcribed; but if on the contrary the plate is poſitive, and the ſpark is negative, then the powder of roſen will be found to fall upon thoſe parts of the plate, which in the other caſe are left uncovered; and to leave the ſtars clean: in ſhort, it will do juſt the reverſe of what it did in the other caſe: or, in other words,

words, the powder of roſin will be attracted by thoſe parts only of the electrophorus, which are electrified poſitively.

When I firſt obſerved theſe phenomena, I thought that there was no apparent reaſon why the powder of roſin ſhould be attracted by thoſe parts of the electrophorus, which are in a poſitive ſtate of electricity, and not by thoſe, which are negative. The two electricities are certainly contrary to one another; but either of them attracts a non-electrified body. On this conſideration I thought, that the experiment could be explained only upon the ſuppoſition, that the powder of roſin, on its falling from the linnen bag, was actually electrified negatively; in which caſe it would have been eaſy to account for the phenomena upon the well known principle of bodies attracting each other when they are contrarily electrified; and repelling one another when they are poſſeſſed of the ſame kind of electricity.

In order to try the reality of my ſuppoſition by experiments, I inſulated a braſs plate upon a glaſs ſtand, and connected a very ſenſible electrometer with it; and then began ſhaking the powder of roſin upon it, in the ſame manner as I had done upon the electrophorus, and in a few ſeconds of time had the pleaſure to ſee the electro-

meter diverge with a very manifeſt degree of negative electricity, anſwering my expectations exactly.

The explanation of the ingenious Profeſſor LICHTENBERG's experiment now became very eaſy and natural; for the powder of roſin, being actually electrified negatively, could not be attracted, except by thoſe parts of the electrophorus, which are in a contrary ſtate, that is, electrified poſitively.

It is obſerved, that powder of roſin anſwers better for this experiment than the powders of other ſubſtances; and accordingly I find, that this powder, when ſhaken upon the inſulated braſs plate, ſhews a ſtronger degree of electricity than the other powders. Indeed the electricity of the powder of roſin, not only when ſhaken upon the braſs plate in the manner above mentioned, but ſimply let fall upon it from a piece of paper, a ſpoon, &c. is remarkably great; half an ounce of it being ſufficient to make the threads of the electrometer diverge as much as they poſſibly can.

This diſcovery not only affords an eaſy explanation of Profeſſor LICHTENBERG's experiment upon the electrophorus, but ſhews a method of exciting powders, which has long been a *deſideratum* in the ſcience of electricity. The method is as follows; inſulate a metal plate upon an electric ſtand, and connect with it a cork-ball electrometer;

then the powder required to be tried being held in a ſpoon, or other thing, about ſix inches above the plate, is to be let fall gradually upon it. In this manner the electricity acquired by the powder, being communicated to the metal plate and to the electrometer, is rendered manifeſt by the divergence of the threads, and its quality may be aſcertained in the uſual manner. See fig. 4.

It muſt be obſerved, that if the powder is of a conducting nature, like the amalgam of metals, ſand, &c. it muſt be held in ſome electric ſubſtance, as a glaſs phial, a plate of ſealing wax, or the like. The metal ſpoon that holds the powder may alſo be inſulated; in which caſe, after the experiment, the ſpoon will be found poſſeſſed of an electricity contrary to that of the powder.

In performing theſe experiments care muſt be had to render the powders, and whatever they are held in, as free from moiſture as poſſible, it being ſometimes neceſſary to make them very warm, otherwiſe the experiments are apt to fail.

The following are the particulars I have obſerved with this new method, which, however, are neither numerous nor often repeated; but they may ſuffice to excite the curioſity of thoſe perſons who have leiſure and the opportunity of repeating them more at large, and in a greater variety.

Powder of roſin, whether it be let fall from paper, glaſs, or a metal ſpoon, electrifies the plate ſtrongly negative; the ſpoon, if inſulated, remaining ſtrongly poſitive. Flower of ſulphur produces the ſame effect, but in a leſs degree.

Pounded glaſs, let fall from a piece of paper, made dry and warm, electrifies the plate negatively, but not in ſo ſtrong a degree as roſin. If it is let fall from a braſs cup, it electrifies the plate poſitively, but in a very ſmall degree.

Steel filings, let fall either from a glaſs phial or paper, electrified the plate negatively; but braſs filings, treated in the ſame manner, electrified the plate poſitively.

The amalgam of tin-foil and quickſilver, gunpowder, or very fine emery, electrify the plate negatively when they are let fall upon it from a glaſs phial.

Quickſilver poured from a glaſs phial electrifies the plate poſitively.

Soot from the chimney, or aſhes from common pit coals mixed with ſmall cinders, electrify the plate negatively, when they are let fall from a piece of paper.

Deſcription of the improved atmoſpherical electrometer.

Fig. 2. is a geometrical repreſentation of my new atmoſpherical electrometer in its real ſize. This inſtrument, the firſt hint of which I received from my ingenious friend THOMAS RONAYNE, Eſq. after various trials, I brought to the preſent ſtate of perfection as long ago as the year 1777; and immediately after ſeveral of them were made after my pattern by Mr. ADAMS, philoloſophical inſtrument maker in Fleet-ſtreet. The great difficulty attending the conſtruction of this inſtrument has long diſſuaded my publiſhing any deſcription of it; nor had I ever troubled the Royal Society with it if the obſervations of ſeveral of my friends, who have uſed it in England and abroad, joined to my own repeated experiments, had not indiſputably confirmed its ſuperiority over any other inſtrument of that kind. Its particular advantages are, 1. The ſmallneſs of the ſize. 2. Its being always ready for experiments, without fear of entangling the threads, or having an equivocal reſult by the ſluggiſhneſs of its motion. 3. Its being not diſturbed by the wind. 4. Its great ſenſibility: and 5, its keeping the communicated electricity longer than any other electrometer hitherto uſed.

The

The principal part of this inſtrument is a glaſs tube CDMN, cemented at the bottom into the wooden piece AB, by which part the inſtrument is to be held when uſed for the atmoſphere, and it alſo ſerves to ſcrew the inſtrument into its wooden caſe ABO, fig. 1. when it is not to be uſed. The upper part of the tube CDMN is ſhaped tapering to a ſmaller extremity, which is entirely covered with ſealing wax melted by heat, and not diſſolved in ſpirits. Into this tapering part a ſmall tube is cemented, which, with its under extremity, touches the flat piece of ivory H, faſtened to the tube by means of cork. The upper extremity of the wire projects about a quarter of an inch above the tube, and ſcrews into the braſs cap EF, which cap is open at the bottom, and ſerves to defend the waxed part of the inſtrument from the rain, &c. In fig. 3. this braſs cap is repreſented as tranſparent, in order to ſhew its internal ſhape, and the manner in which it is ſcrewed to the wire projecting above the tube L. The ſmall tube L and the upper extremity of the large tube CDMN appear like one continued piece, on account of the ſealing wax which covers them both. The conical corks P of this electrometer, which by their repulſion ſhew the electricity, &c. are as ſmall as they can conveniently be made, and they are ſuſpended by exceedingly fine ſilver wires: theſe wires are ſhaped in a ring

ring at the top, by which they hang very loosely to the flat piece of ivory H, which has two holes for that purpose. By this method of suspension the friction is lessened almost to nothing, and thence the instrument is sensible of a very small degree of electricity. IM and KN are two narrow slips of tin-foil stuck to the inside of the glass CDMN, and communicating with the wooden bottom AB; they serve to convey off that electricity, which, when the corks touch the glass, is communicated to it, and being accumulated might disturb the free motion of the corks.

In regard to its use, this instrument may be used to observe the artificial as well as the atmospherical electricity. When it is to be used for artificial electricity, this electrometer is set upon a table or other convenient support; then it is electrified by touching the brass cap EF with an electrified body, which electricity will sometimes be preserved for more than an hour; in this state, if any electrified substance is brought near the cap EF, the corks of the electrometer by their converging or diverging more, will shew the species of that body's electricity.

Before we proceed farther, it is necessary to remark, that the communication of any electricity to this electrometer, by means of an excited electric, for instance, a piece of sealing wax (which we suppose as always electrified

trified negatively) is not very readily done in the uſual manner, becauſe of the cap EF being well rounded, and free from points or ſharp edges. By the approach of the wax the electrometer will be cauſed to diverge; but as ſoon as the wax is removed, the wires immediately collapſe. The beſt method to electrify it is, to bring the excited wax ſo near the cap that one or both the corks may touch the ſide of the bottle CDMN; after which they will ſoon collapſe and appear unelectrified. If now the wax is removed, they will again diverge and remain electrified poſitively. In this operation the wax does not impart any of its electricity to the electrometer, but only acts by means of its atmoſphere, *viz.* when the excited wax is firſt brought near the braſs cap EF (agreeable to the well known law of electricity, and according to Dr. FRANKLIN's hypotheſis) it determines the electric fluid, naturally belonging to the corks, towards the cap; hence the corks repel each other. Now if in this ſtate they touch the ſides of the glaſs CDMN, they acquire from it a quantity of electric fluid equal to that, which, by the action of the excited wax, was driven towards the cap, conſequently they collapſe and appear unelectrified. Notwithſtanding this appearance, the cap is actually overcharged, ſo that when the wax is removed, the overplus of the electric fluid, which the corks had acquired

from

from the glaſs, and tin-foil ſtuck upon it, and which was crouded upon the cap, becauſe the negative atmoſphere of the wax now diffuſes itſelf equally through the cap, the wires, the corks, &c.; and, therefore, the corks repel each other with poſitive electricity.

If, inſtead of the ſealing wax excited negatively, an electric poſſeſſed of poſitive electricity be uſed, the electrometer acquires the negative electricity, and the explanation, *mutatis mutandis*, is the ſame as above.

By conſidering this remark it will appear, that when this electrometer is electrified, either poſitively or negatively, and an electrified body is brought towards the braſs cap; the electricity of that body will be of the ſame kind with that of the electrometer, if the corks increaſe their divergency; but it will be of the contrary kind, if the corks approach one another.

When this inſtrument is to be uſed to try the electricity of the fogs, the air, the clouds, &c. the obſerver is to do nothing more than to unſcrew it from its caſe, and, holding it by the bottom AB, to preſent it to the open air a little above his head, ſo that he may conveniently ſee the corks P, which will immediately diverge if there is any electricity; the kind of which, that is, whether poſitive or negative, may be aſcertained by bringing an excited

piece of ſealing wax, or other electric, towards the braſs cap EF.

It is, perhaps, unneceſſary to remark, that this obſervation muſt be made in an open place, as the roads out of town, the fields, the top of a houſe, &c.

I have often made uſe of this electrometer in the roads between Iſlington and London, and by means of it I have confirmed the obſervation of Mr. RONAYNE, who firſt diſcovered the electricity of the fogs, as is teſtified by a paper of his publiſhed in the Philoſophical Tranſactions, and who has remarked, that a fog is very rarely not electrified; and that in clear froſty weather the air is conſtantly electrified.

Promiſcuous Experiments.

I. Having had frequent occaſion to obſerve how difficult it is to deprive ſealing wax of its electricity entirely, after that it has been well excited, I had the curioſity to try whether water could effect it. In order to that, I tied a ſtick of ſealing wax to a ſilk ſtring about a yard long, and after having excited it very powerfully with flannel, I plunged it in a tin veſſel full of water, and immediately drawing

drawing it out, brought a very accurate electrometer near it, and obſerved, that at firſt it ſhewed no ſign of electricity; but in about half a minute's time it manifeſted a ſmall but very ſenſible degree of negative electricity. A glaſs tube, treated in the ſame manner, was deprived of all its electricity by the water.

II. I have often remarked, that after having excited a glaſs tube with the amalgamated rubber in the uſual manner, the part of it which had been under my hand was negative. This minus ſtate was ſtill more conſpicuous when I graſped with my hand the part next above, *viz.* part of that which had been excited poſitively by rubbing. In the ſame manner, when I excite a ſtick of ſealing wax, by rubbing it with flannel, I often find, that the part of it which I hold in my hand is in a contrary ſtate of electricity, *viz.* poſitive.

III. Being deſirous of trying the conducting power of the effluvia of burning bodies in a manner more ſatisfactory than had hitherto been done, I contrived an inſtrument for that purpoſe, which is repreſented in fig. 5.[a].

The handle of it AB is a glaſs tube, into the extremity B of which a wire EI, and a ſmaller glaſs tube BC, are cemented

(a) This inſtrument is juſt double the ſize of the figure.

mented by means of ſealing wax. From the extremity of this ſmall tube another wire FG proceeds, which, as well as the wire EI, is bent at the top, ſo that the extremities of both wires EF may be about one tenth of an inch from one another. GH is a ſmall wire faſtened to the wire FG, and to the extremity of the handle, ſo that when the inſtrument is held in one's hand, this wire touches the hand. K is a ſmall cork-ball electrometer, which, when the inſtrument is to be uſed, is affixed to the pin D, which proceeds from the wire IE. When experiments are to be tried with this inſtrument, the electrometer K muſt be affixed to the pin D, which proceeds from the wire IE, and muſt be electrified ſo that the cork balls may diverge as far as poſſible: this done, the extremities EF of the wires are brought within the effluvia that are to be tried, which, if they are of a good conducting nature, will complete the communication between the two wires EF, and diſcharge the electrometer of its electricity, otherwiſe the electrometer will remain electrified for a conſiderable time.

The experiments which I have made with this inſtrument are neither numerous nor ſo often repeated as to be depended upon, excepting one only, which, perhaps, it will be not uſeleſs to mention. I found that the fumes

ariſing

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

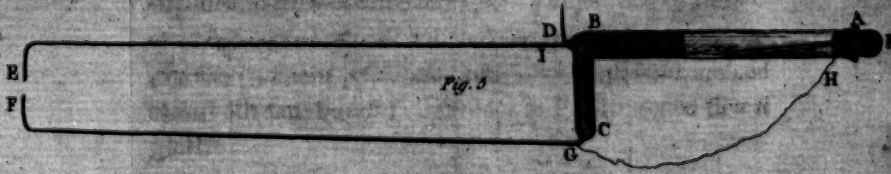


Fig. 5.

T. Cargill. Del.

Basire. Sc.

arising by the action of a lens, from the amalgam of tin-foil and mercury, conducted so badly, that the electrometer lost its electricity in a time very little less than it would have done without any fumes whatever.

Little St. Martin's Lane,
Nov. 4, 1779.

III. *A new Method of aſſaying Copper Ores.* By George Fordyce, *M. D. F. R. S.*

Read Nov. 25, 1779.

PROCESS.

TAKE 100 grains of the ore, powder it finely, put it into a ſmall matraſs or a glaſs phial, pour upon it half an ounce of nitrous acid, of the ſtrength commonly ſold by the name of *aqua fortis*, that is, the pure acid diluted with about four times its weight of water; and half an ounce of muriatic acid ſold by the name of ſpirit of ſalt; place the veſſel in a ſand heat, or if you have none, an iron pot or fire ſhovel with ſand may be put over a common fire, and the matraſs or phial ſet in it. Raiſe a moderate heat, an effervеſcence will take place for the moſt part; when this ceaſes increaſe the heat till it is renewed, and ſo proceed till the liquor boils, which is alſo to be done if no effervеſcence takes place; boil them together for a quarter of an hour.

Remove the veſſel from the fire, and let it cool, then pour into it two ounces of water, ſhake them together,

and let them ſtand till the liquor is clear; pour the clear liquor into a baſon where it may be preſerved.

Add to the *reſiduum* a freſh half ounce of each of the acids, and proceed again in the ſame manner, mixing the clear liquor with that procured by the firſt proceſs.

The ſame operation is to be repeated until the freſh acids acquire no tinge of blue or green.

Diſſolve half a pound of mild fixed vegetable alkali, commonly ſold by the name of ſalt of tartar, in a quart of water. Purify the ſolution either by filtration, or letting the impurities ſubſide, and decanting the liquor clear into a glaſs veſſel. Pour the ſolution of the alkali ſlowly into the baſon containing the fluid, procured by the former proceſſes, until the whole matter be precipitated from the acids.

Add, by a little at a time, as much vitriolic acid, commonly ſold by the name of oil of vitriol, as will re-diſſolve the whole, or only leave a white powder; if there ſhould be any ſuch powder, which is ſeldom the caſe, it muſt be ſeparated by filtration.

Having the liquor in the baſon now clear, put into it a piece of iron, bright and free from ruſt, and at leaſt an ounce in weight, and leave them together for twenty-four hours, the copper will be found precipitated, principally on the ſurface of the iron, and ſometimes in a powder at the bottom of the baſon.

Decant

Decant the fluid from the copper and iron with great care into another baſon, ſo that as little as poſſible or none of the copper be carried along with it.

Waſh the metals in a pint of water; let them ſubſide perfectly, and pour this water into the ſecond baſon, with the ſame care,

Repeat the waſhing three times. If any copper be found in the ſecond baſon, let the waſhings ſtand in it for half an hour, ſo that the metal ſhall ſubſide; decant the fluid carefully off, and return the copper into the firſt baſon. Pour upon the copper and iron one ounce of vitriolic acid, and two ounces of water; let them ſtand together for a quarter of an hour, or until the copper ſhall be eaſily ſeparable from the iron. Separate the copper from the iron, taking great care none be loſt; the remaining iron may be laid aſide. Pour the acid from the copper, after it has ſubſided, into the ſecond baſon, and waſh the copper with a pint of water, and repeat the waſhing three times, as before directed.

Great care is to be taken, in decanting both the acid and waſhings into the ſecond baſon, that none of the copper goes along with them, and leſt any ſhould, they ought to ſtand for half an hour in the ſecond baſon, and be decanted from it alſo with care, and if any copper is

found at the bottom, it is to be waſhed and added to the reſt.

The copper is now to be dried and weighed, and gives the proportion contained in the ore.

Obſervations on the above proceſs.

It is about twenty years ago that I contrived ſome methods of aſſaying ores, which might avoid tedious and troubleſome roaſtings and fuſions in great degrees of heat, which require a dexterity which is only to be acquired by great practice, and which after all form a proceſs that is often various in the reſult, and ſeldom ſhews the ſubſtances contained in the ore, excepting the metal. The principles on which theſe proceſſes depend, as far as regards copper ores, are,

Firſt, Metals are attracted more ſtrongly by acids than by ſulphur, with which they are often combined in their ores. In conſequence, if a metal be combined with ſulphur in an ore, it may be ſeparated by applying an acid, which will unite with the metal, and ſeparate the ſulphur. The metal may generally be ſeparated from the acid in its metallic form by means of another metal, which attracts the acid more ſtrongly.

Secondly, Arſenic unites with vitriolic, nitrous, and muriatic acids, forming a corroſion or compound not ſoluble in water; whereas moſt other metals may be united with one of theſe acids, or a mixture of them, ſo as to form a compound ſoluble in water: therefore, if there be arſenic combined with a metal in an ore, if it be diſſolved in ſuch acid diluted with water, the arſenic will fall to the bottom in a white powder or cryſtals, and the ſolution being poured off will contain the metal, which may be ſeparated from the acid by another metal as before.

Thirdly, the calces of metals may be diſſolved in acids, whether they be pure (of which there are few inſtances in ores) or combined with gas, reſpirable air, or other vapours; therefore, if the metal in an ore be in the form of a calx, we may find an acid which will diſſolve it, and we may afterwards precipitate it in its metallic form as before.

Fourthly, When an ore is to be aſſayed, it ſhould be ſeparated from the quartz, ſpars, and other earthy matters, with which it is often mixed, as perfectly as poſſible; however, after all our care there will be often a part of them ſo intimately mixed with the ore, that it cannot be entirely cleared. Many of theſe earthy matters do not diſſolve readily in acids: therefore, if the metal of an

ore

ore be diſſolved in an acid, ſo as to form a compound ſoluble in water, the ſolution of the metal may be poured off, leaving ſuch earthy matters behind.

Fifthly, If the earthy matter ſhould diſſolve in the acid, it is ſeldom to be precipitated by a metal: therefore if both earth and metal be diſſolved, on the application of another metal, which attracts the acid more ſtrongly, that which was combined with the acid will be precipitated, and the earth left in the ſolution.

Sixthly, Acids attract the metals with different powers: therefore, if two metals be combined with an acid, if we apply to the ſolution a maſs of that which attracts the acid ſtrongeſt, the other will be precipitated. The maſs being weighed before and after the precipitation, the difference will be the quantity of additional metal diſſolved; if, therefore, we pour off the liquid from the precipitate, and apply another metal, which attracts the acid ſtill more ſtrongly, the ſecond metal will be precipitated, which being weighed, and the weight loſt from the maſs deducted, gives the weight of the ſecond metal. As this principle is of great uſe in inveſtigating the elements of mixed metals, we ſhall give an example. Suppoſe copper and ſilver mixed; diſſolve the whole in pure nitrous acid, properly diluted with water; apply to the ſolution a maſs of copper, the ſilver will be precipitated.

Pour off the ſolution, and waſh the ſilver and undiſſolved copper with water; pour the waſhings into the ſolution; weigh the maſs of copper left, and mark what it has loſt; apply to the ſolution a maſs of iron, the whole copper will be precipitated. Pour off the fluid, and waſh the precipitate carefully, dry it, and weigh it, deduct the weight loſt from the maſs of copper, what remains is the weight of the copper in the mixture; if this weight, together with that of the ſilver, be the weight of the metal originally expoſed to examination, there is no reaſon to ſuſpect any mixture of another metal.

If the metals mixed are unknown, if we can find an acid which will diſſolve them, we may try to make a precipitation with the metal which is loweſt but one in the order of elective attractions, and ſo proceed to the next above it, until we come to the higheſt; and by this means we ſhall obtain all the metals in the maſs.

There are other principles on which I have founded various proceſſes for aſſaying; but theſe are ſufficient for copper ores, all the different known ſpecies of which I have actually aſſayed, and therefore have ventured to offer this proceſs to the conſideration of the Society; firſt, as only requiring an apparatus which can be bought at any apothecary's or chemiſts, and as capable of being performed by a perſon totally unacquainted with

with chemiſtry, ſo that any proprietor of an eſtate, or his ſervant, may determine if an ore be of copper, and its value; ſecondly, as affording an aſſay-maſter a more perfect manner of determining the value of a copper ore; and, laſtly, as a proceſs by which the naturaliſt may inveſtigate not only the copper in an ore, but its various other contents.

There is but one known ſpecies of copper ore in which the copper is not capable of being combined with *aqua regia*, which is blue vitriol, which is ſometimes found ſolid, but more frequently in mineral waters; from this the copper may be precipitated by iron immediately.

We have lately had many opinions publiſhed of metals being found in mineral waters combined with various ſubſtances. I never examined any mineral water in which I found the metals combined with any other ſubſtance but vitriolic acid; and am certain, many authors have been miſled by not knowing this property of metallic ſalts, *viz.* that if we diſſolve them in a ſmall proportion of water, or if there be ſuperfluous acid, the ſolution will remain perfect when expoſed to the air; but if the acid be perfectly ſaturated with the metal, and the proportion of water to the metallic ſalt be very great, on expoſure to the air it is decompoſed, the metal precipitating in the form of a calx, and the acid being loſt.

This

This may eaſily be tried by taking common green or blue vitriol, diſſolving an ounce in three ounces of water by boiling, letting them ſtand to cool, and filtering the ſolution. If this ſolution be expoſed to the air it will remain perfect; but if we drop a drop or two of it into a wine glaſs full of water, in a few minutes the tranſparency of the water will begin to be diſturbed, and the metal in a ſhort time will fall down, in a red powder if it be iron, in a blue powder if it be copper.

An hundred grains of the ore is ſufficient to give the copper contained to one hundred part; if greater accuracy be required 1000 grains may be uſed.

The mixture of nitrous and muriatic acid is the moſt proper acid *menſtruum* for copper ores, muriatic acid diſſolving moſt readily the calces of metals, and nitrous acid when they are in their metallic form; a metal in its metallic form being a compound of a pure calx and a ſubſtance, which has been called inflammable air, but which is an oil found out by STAHL to exiſt in metals, and which we would call the oil of metals. The nitrous acid decompoſes this oil, at the ſame time that it acts on the calx itſelf, and leaves it alſo to be acted upon by the muriatic acid.

When copper is combined with ſulphur in an ore, it is in its metallic form; in diſſolving in an acid its oil riſes in

in vapour; or vapours produced by the decompoſition of this oil occaſion an effervescence.

All the calces of copper I have tried are combined with gas, reſpirable air, or other vapours, excepting one, which is of a light green colour, brittle, and which breaks ſmooth like glaſs; a ſpecimen of it is contained in Dr. HUNTER'S muſeum: this diſſolves without effervescence, the others all effervesce. A boiling heat is neceſſary to render the ſolution compleat, of which great care is to to be taken.

If there be any ſulphur in the ore, it appears quite clear in lumps; a ſmall portion of it, however, is deſtroyed by the nitrous acid. Earthy matters inſoluble in acids, if any, and arſenic, appear in a powder at the bottom. If there be any ſilver it is mixed with this powder, and is to be extracted by melting it with black flux and litharge, and cupelling in the common way. If there be any gold it may be taken out of the ſolution by æther.

When the copper is combined with nitrous and muriatic acids, it might be thought ſufficient to apply the iron immediately; but it is much more convenient to precipitate it from them, and combine it with vitriolic acid, on account of the convenience of waſhing the precipitate, which is in a more compacted maſs.

If

If there be any calcareous earth diſſolved, the vitriolic acid will combine with it, and form a white powder, which will be left after the copper is re-diſſolved, and muſt be ſeparated carefully from the ſolution.

After the precipitation of the copper, it is neceſſary to get rid of the ſalts perfectly before we apply the vitriolic acid, otherwiſe part of the copper would be re-diſſolved.

Vitriolic acid will not diſſolve copper in its metallic form, and may be applied to diſſolve any iron that may be mixed with the precipitate, as well as to looſen copper, which ſometimes adheres to the iron.

The ſolution of the iron muſt be carefully waſhed off from the copper.

There is a criterion by which we may judge certainly if any of the copper be loſt. Let all the waſhings and every thing, except the copper, be put into a veſſel together; pour in ſolution of fixed alkali till no further precipitation takes place; let the precipitate ſubſide, and pour off the liquor; apply to the precipitate ſolution of volatile alkali, ſold by the name of ſpirit of *ſal ammoniac*; ſhake them together, and let them ſtand for an hour; if the ſolution of the alkali acquires a purpliſh blue colour, the proceſs is imperfect, if it does not, it is perfect.

If the process be imperfect, which is always for want of care in the decantations, pour in as much vitriolic acid as will dissolve the whole precipitate, apply iron to the solution, the remaining copper will be procured.

IV. *An Account of an Eruption of Mount Veſuvius, which happened in* Auguſt, 1779. *In a Letter from Sir* William Hamilton, *K. B. F. R. S. to* Joſeph Banks, *Eſq. P. R. S.*

Read Dec. 16, 1779.

SIR, Naples, October 1, 1779.

THE late eruption of Mount Veſuvius was of ſo ſingular a nature, ſo very violent and alarming, that it neceſſarily attracted the attention of every one, not only in its immediate neighbourhood, but for many miles around; and, conſequently, ſeveral ſlight deſcriptions of it have been already handed about, and ſome (as I am informed) more accurate and circumſtantial are preparing for the preſs [a].

That on which the Abbot BOTTIS is actually employed, by command of his Sicilian Majeſty, will undoubtedly be executed with the ſame accuracy, truth,

(a) The inhabitants of this great city in general give ſo little attention to Mount Veſuvius, though in full view of the greateſt part of it, that I am well convinced many of its eruptions paſs totally unnoticed by at leaſt two thirds of them.

and preciſion, as have rendered that author's former publications upon the ſubject of Mount Veſuvius ſo univerſally and deſervedly eſteemed.

Such a publication, executed with magnificence in the royal printing office, may, perhaps, render every other account of the late eruption ſuperfluous: nevertheleſs, I ſhould think myſelf in ſome degree guilty of a neglect towards the Royal Society, who have done ſo much honour to my former communications, if I did not, through the reſpectable canal of its worthy preſident, and my good friend, ſimply relate to them ſuch remarkable circumſtances as attended the late tremendous exploſions of Mount Veſuvius, and as either came immediately under my own inſpection, or have been related to me by ſuch good authority as cannot be called in queſtion.

Since the great eruption of 1767, of which I had the honour of giving a particular account to the Royal Society, Veſuvius has never been free from ſmoke, nor ever many months without throwing up red-hot ſcoriæ, which, increaſing to a certain degree, were uſually followed by a current of liquid lava, and except in the eruption of 1777, thoſe lavas broke out nearly from the ſame ſpot, and ran much in the ſame direction, as that of the famous eruption of 1767.

No leſs than nine ſuch eruptions are recorded here ſince the great one abovementioned, and ſome of them were conſiderable. I never failed viſiting thoſe lavas whilſt they were in full force, and as conſtantly examined them and the crater of the volcano after the ceaſing of each eruption [b].

It would be but a repetition of what has been deſcribed in my former letters on this ſubject, were I to relate my remarks on thoſe different expeditions. The lavas, when they either boiled over the crater, or broke out from the conical parts of the volcano, conſtantly formed channels as regular as if they had been cut by art down the ſteep part of the mountain, and, whilſt in a ſtate of perfect fuſion, continued their courſe in thoſe channels, which were ſometimes full to the brim, and at other times more or leſs ſo, according to the quantity of matter in motion.

Theſe channels, upon examination after an eruption, I have found to be in general from two to five or ſix feet

(b) The laſt viſit to the crater of Veſuvius, which was in the month of May, 1779, was my fifty-eighth, and to be ſure I have been four times as often on parts of the mountain, without climbing to its ſummit, and after all am not aſhamed to own, that I comprehend very little of the wonders I have ſeen in this great laboratory of nature; yet there have been naturaliſts of ſuch a wonderful penetrating genius, as to have thought themſelves ſufficiently qualified to account for every hidden phenomenon of Veſuvius, after having, literally ſpeaking, given the volcano *un coup d'œil*.

wide, and ſeven or eight feet deep. They were often hid from the ſight by a quantity of *ſcoriæ* that had formed a cruſt over them, and the lava having been conveyed in a covered way for ſome yards, came out freſh again into an open channel. After an eruption I have walked in ſome of thoſe ſubterraneous or covered galleries which were exceedingly curious, the ſides, top and bottom, being worn perfectly ſmooth and even in moſt parts by the violence of the currents of the red-hot lavas, which they had conveyed for many weeks ſucceſſively; in others, the lava had incruſted the ſides of thoſe channels with ſome very extraordinary *ſcoriæ:* beautifully ramified white ſalts [c], in the form of dropping ſtalactites, were alſo attached to many parts of the cieling of thoſe galleries. It is imagined here, that the ſalts of Veſuvius are chiefly ammoniac, though often tinged with green, deep, or pale yellow, by the vapour of various minerals.

In the month of May laſt, there was a conſiderable eruption of Mount Veſuvius, when I paſſed a night on the mountain in the company of one of my countrymen, as eager as myſelf in the purſuit of this branch of natural hiſtory [d].

(c) I ſent a large ſpecimen of this curious volcanic production to the Britiſh Muſeum laſt year.

(d) Mr. BOWDLER, of Bath.

We

We ſaw the operation of the lava, in the channels as abovementioned, in the greateſt perfection; but it was, indeed, owing to our perſeverance, and ſome degree of reſolution. After the lava had quitted its regular channels, it ſpread itſelf in the valley, and, being loaded with *ſcoriæ*, ran gently on, like a river that had been frozen, and had maſſes of ice floating on it: the wind changing when we were cloſe to this gentle ſtream of lava, which might be about fifty or ſixty feet in breadth, incommoded us ſo much with its heat and ſmoke, that we muſt have returned without having ſatisfied our curioſity, had not our guide (*t*) propoſed the expedient of walking acroſs it, which, to our aſtoniſhment, he inſtantly put in execution, and with ſo little difficulty, that we followed him without heſitation, having felt no other inconvenience than what proceeded from the violence of the heat on our legs and feet; the cruſt of the lava was ſo tough, beſides being loaded with cinders and *ſcoriæ*, that our weight made not the leaſt impreſſion on it, and its motion was ſo ſlow, that we were not in any danger of loſing our balance and falling on it: however, this experiment ſhould not be tried except in caſes of real neceſſity; and I mention it with no other view than to point out a poſ-

(*t*) BARTOLOMEO, the Cyclops of Veſuvius, who has attended me on all my expeditions to the mountain, and who is an excellent guide.

ſibility

ſibility of eſcaping, ſhould any one hereafter, upon ſuch an expedition as ours, have the misfortune to be incloſed between two currents of lava.

Having thus got rid of the troubleſome heat and ſmoke, we coaſted the river of lava and its channels up to its very ſource, within a quarter of a mile of the crater. The liquid and red-hot matter bubbled up violently, with a hiſſing and crackling noiſe, like that which attends the playing off of an artificial firework, and by the continual ſplaſhing up of the vitrified matter, a kind of arch or dome was formed over the crevice from whence the lava iſſued. It was cracked in many parts, and appeared red-hot within, like an heated oven: this hollowed hillock might be about fifteen feet high, and the lava that ran from under it was received into a regular channel, raiſed upon a ſort of wall of *ſcoriæ* and cinders, almoſt perpendicularly, of about the height of eight or ten feet, reſembling much an ancient aqueduct.

We then went up to the crater of the volcano, in which we found, as uſual, a little mountain throwing *ſcoriæ* and red-hot matter with loud exploſions; but the ſmoke and ſmell of ſulphur was ſo intolerable, that we were under the neceſſity of quitting that curious ſpot with the utmoſt precipitation.

In

In another of my excurſions to Mount Veſuvius laſt year, I picked up ſome fragments of large and regular cryſtals of cloſe-grained lava or baſalt, the diameter of which, when the priſms were complete, may have been eight or nine inches. As Veſuvius does not exhibit any lava's regularly cryſtallized, and forming what are vulgarly called Giants Cauſeways (except a lava that ran into the ſea near Torre del Greco in 1631, and which in a ſmall degree has ſuch an appearance), this diſcovery gave me the greateſt pleaſure (*f*).

After this ſlight ſketch of the moſt remarkable events on Veſuvius ſince the year 1767, which I flatter myſelf will not be unacceptable, as it may ſerve to connect what I am going to relate with what has already been communicated to the Society in my former letters on the ſame ſubject, I come to the account of the late eruption, which affords indeed ample matter for curious ſpeculation.

(*f*) As the fragments of baſalt columns, which I found on the cone of Veſuvius, had been evidently thrown out of its crater, may not lava be more ſubject to cryſtallize within the bowels of a volcano than after its emiſſion, and having been expoſed to the open air? And may not many of the Giants Cauſeways, already diſcovered, be the *nuclei* of volcanic mountains, whoſe lighter and leſs ſolid parts may have been worn away by the hand of time? Mr. FAUJEIS DE ST. FOND, in his curious book lately publiſhed, and intitled, "Recherches ſur les Volcains éteints du Vivarais et du Velay," gives (p. 286.) an example of baſalt columns, that are placed deep within the crater of an extinguiſhed volcano.

As

As many poetical deſcriptions of this eruption will not be wanting, I ſhall confine mine to ſimple matter of fact in plain proſe, and endeavour to convey to you, SIR, as clearly and as diſtinctly as I am able, what I ſaw myſelf, and the impreſſion it made upon me at the time, without aiming in the leaſt at a flowery ſtyle.

The uſual ſymptoms of an approaching eruption, ſuch as rumbling noiſes and exploſions within the bowels of the volcano, a quantity of ſmoke iſſuing with force from its crater, accompanied at times with an emiſſion of red-hot *ſcoriæ* and aſhes, were manifeſt, more or leſs, during the whole month of July; and towards the end of the month, thoſe ſymptoms were increaſed to ſuch a degree as to exhibit in the night-time the moſt beautiful fire-works that can be imagined.

Theſe kinds of throws of red-hot *ſcoriæ* and other volcanic matter, which at night are ſo bright and luminous, appear in broad day-light like ſo many black ſpots in the midſt of the white ſmoke; and it is this circumſtance that occaſions the vulgar and falſe ſuppoſition, that volcanos burn much more violently at night than in the day-time.

On Thurſday, the 5th of Auguſt laſt, about two o'clock in the afternoon, I perceived from my villa at Pauſilipo in the bay of Naples, from whence I have a

full view of Veſuvius (which is juſt oppoſite, and at the diſtance of about ſix miles in a direct line from it) that the volcano was in a moſt violent agitation: a white and ſulphureous ſmoke iſſued continually and impetuouſly from its crater, one puff impelling another, and by an accumulation of thoſe, clouds of ſmoke reſembling bales of the whiteſt cotton. Such a maſs of them was ſoon piled over the top of the volcano as exceeded the height and ſize of the mountain itſelf at leaſt four times. In the midſt of this very white ſmoke, an immenſe quantity of ſtones, *ſcoriæ*, and aſhes, were ſhot up to a wonderful height, certainly not leſs than two thouſand feet. I could alſo perceive, by the help of one of RAMSDEN's moſt excellent refracting teleſcopes, at times, a quantity of liquid lava, ſeemingly very weighty, juſt heaved up high enough to clear the rim of the crater, and then take its courſe impetuouſly down the ſteep ſide of Veſuvius, oppoſite to Somma. Soon after a lava broke out on the ſame ſide from about the middle of the conical part of the volcano, and, having run with violence ſome hours, ceaſed ſuddenly, juſt before it had arrived at the cultivated parts of the mountain above Portici, near four miles from the ſpot where it iſſued.

During this day's eruption, as I have been credibly informed ſince, the heat was intolerable at the towns of

Somma and Ottaiano; and was likewiſe ſenſibly felt at Palma and Lauro, which are much farther from Veſuvius than the former. Minute aſhes, of a reddiſh hue, fell ſo thick at Somma and Ottaiano, that they darkened the air in ſuch a manner as that objects could not be diſtinguiſhed at the diſtance of ten feet. Long filaments of a vitrified matter like ſpun-glaſs were mixed and fell with theſe aſhes (t); and the ſulphureous ſmoke was ſo violent, that ſeveral birds in cages were ſuffocated, the leaves of the trees in the neighbourhood of Somma and Ottaiano were covered with white ſalts very corroſive. About two o'clock in the afternoon, an extraordinary globe of ſmoke, of a very great diameter, was diſtinctly perceived, by many of the inhabitants of Portici, to iſſue from the crater of Veſuvius, and proceed haſtily towards the mountain of Somma, againſt which it ſtruck and diſperſed itſelf, having left a train of white ſmoke, mark-

(t) During an eruption of the volcano in the iſle of Bourbon in 1766, ſome miles of country, at the diſtance of ſix leagues from that volcano, were covered with a flexible, capillary, yellow glaſs, ſome of which were two or three feet long, with ſmall vitrous globules at a little diſtance one from the other. Count BUFFON ſhewed me ſome of this capillary and flexible glaſs, which is preſerved in the Royal Muſeum at Paris, and which perfectly reſembles the filaments of vitrified matter which fell at Ottalano and in other parts on the borders of Veſuvius during this eruption. SORRENTINO, in his Iſtoria del Veſuvio, publiſhed at Naples in 1734, likewiſe mentions vitrified matter, like herbs and ſtraw, being found on the ground in the neighbourhood of Veſuvius during an eruption of that mountain in the year 1724.

ing the courſe it had taken: this train I perceived plainly from my villa, as it laſted ſome minutes; but I did not ſee the globe itſelf.

A poor labourer, who was making faggots on the mountain of Somma, loſt his life at this time, and his body not having been found, it is ſuppoſed that, ſuffocated by the ſmoke, he muſt have fallen into the valley from the craggy rocks on which he was at work, and been covered by the current of lava that took its courſe through that valley ſoon after. An aſs, that was waiting for its maſter in the valley, left it very judiciouſly as ſoon as the mountain became violent, and, arriving ſafe home, gave the firſt alarm to this poor man's family.

It was generally remarked, that the exploſions of the volcano were attended with more noiſe during this day's eruption than in any of the ſucceeding ones, when, moſt probably, the mouth of Veſuvius was widened, and the volcanic matter had a freer paſſage. It is certain, however, that the great eruption of 1767 (which in every other reſpect was mild, when compared to the late violent eruption) occaſioned much greater concuſſions in the air by its louder exploſions.

Friday, Auguſt the 6th, the fermentation in the mountain was leſs violent; but, about noon, there was a loud report, at which time it was ſuppoſed, that a portion of

of the little mountain within the crater had fallen in. At night the throws from the crater increaſed, and proceeded evidently from two ſeparate mouths, which emitting red-hot *ſcoriæ*, and in different directions, formed a moſt beautiful and almoſt continued fire-work.

On Saturday, Auguſt the 7th, the volcano remained much in the ſame ſtate; but, about twelve o'clock at night, its fermentation increaſed greatly. The ſecond fever-fit of the mountain may be ſaid to have manifeſted itſelf at this time. I was watching its motions from the mole of Naples, which has a full view of the volcano, and had been witneſs to ſeveral glorious picturesque effects produced by the reflection of the deep red fire, which iſſued from the crater of Veſuvius, and mounted up in the midſt of the huge clouds, when a ſummer ſtorm, called here *a tropea*, came on ſuddenly, and blended its heavy watry clouds with the ſulphureous and mineral ones, which were already like ſo many other mountains, piled over the ſummit of the volcano; at this moment a fountain of fire was ſhot up to an incredible height, caſting ſo bright a light, that the ſmalleſt objects could be clearly diſtinguiſhed at any place within ſix miles or more of Veſuvius.

The black ſtormy clouds paſſing ſwiftly over, and at times covering the whole or a part of, the bright column

of

of fire, at other times clearing away, and giving a full view of it, with the various tints produced by its reverberated light on the white clouds above, in contraſt with the pale flaſhes of forked lightning that attended the *tropea*, formed ſuch a ſcene as no power of art can ever expreſs.

That which followed the next evening was ſurely much more formidable and alarming; but this was more beautiful and ſublime than even the moſt lively imagination can paint to itſelf. This great exploſion did not laſt above eight or ten minutes, after which Veſuvius was totally eclipſed by the dark clouds, and there fell a heavy ſhower of rain.

Some *ſcoriæ* and ſmall ſtones fell at Ottaiano during this eruption, and ſome of a very great ſize in the valley between Veſuvius and the Hermitage. All the inhabitants of the towns at the foot of the volcano were in the greateſt alarm, and preparing to abandon their houſes, had the eruption continued longer.

One of his Sicilian Majeſty's game-keepers, who was out in the fields near Ottaiano, whilſt this combined ſtorm was at its height, was greatly ſurprized to find the drops of rain ſcald his face and hands, which phenomenon was probably occaſioned by the clouds having acquired a great degree of heat in paſſing through the

above

above mentioned column of fire. The King of Naples did me the honour of informing me of this curious circumſtance.

Sunday, Auguſt the 8th, Veſuvius was quiet till towards ſix o'clock in the evening, when a great ſmoke began to gather again over its crater, and about an hour after, a rumbling ſubteranneous noiſe was heard in the neighbourhood of the volcano; the uſual throws of red-hot ſtones and *ſcoriæ* began, and increaſed every inſtant. I was at this time at Pauſilipo, in the company of ſeveral of my countrymen, obſerving with good teleſcopes the curious phenomena in the crater of Veſuvius, which, with ſuch help, we could diſtinguiſh as well as if we had been actually ſeated on the ſummit of the volcano. The crater ſeemed much enlarged by the violence of laſt night's exploſions, and the little mountain no longer exiſted. At about nine o'clock there was a loud report, which ſhook the houſes at Portici and its neighbourhood to ſuch a degree as to alarm their inhabitants, and drive them out into the ſtreets; and, as I have ſince ſeen, many windows were broken, and walls cracked, by the concuſſion of the air from that exploſion, though faintly heard at Naples.

In an inſtant a fountain of liquid tranſparent fire began to riſe, and, gradually increaſing, arrived at ſo amazing a height

a height as to ſtrike every one who beheld it with the moſt awful aſtoniſhment. I ſhall ſcarcely be credited when I aſſure you, SIR, that, to the beſt of my judgment, the height of this ſtupendous column of fire could not be leſs than three times that of Veſuvius itſelf, which, as you know, riſes perpendicularly near 3700 feet above the level of the ſea [b].

Puffs of ſmoke, as black as can poſſibly be imagined, ſucceeded one another haſtily, and accompanied the red-hot, tranſparent, and liquid lava, interrupting its ſplendid brightneſs here and there by patches of the darkeſt hue. Within theſe puffs of ſmoke, at the very moment of their emiſſion from the crater, I could perceive a bright, but pale, electrical fire, briskly playing about in zig zag lines [i].

The wind was S.W.; and though gentle was ſufficient to carry theſe detached clouds or puffs of ſmoke out of the column of fire, and a collection of them, by degrees, formed a black and extenſive curtain (if I may be al-

(b) Se tu ſe' or lettore, a creder lento
Ciò, ch'e Io dirò, non ſarà maraviglia;
Che Io, che l' vidi; appena il mi conſento.

DANTE INF. Cant. XXV. verſo 46.

(i) I mention this circumſtance to prove, that the electrical matter, ſo manifeſt during this eruption, actually proceeded from the bowels of the volcano, and was not attracted from a great height in the air, and conducted into its crater by the vaſt column of ſmoke.

lowed the expreſſion) behind it; in other parts of the ſky it was perfectly clear, and the ſtars were bright.

The fiery fountain, of ſo gigantic a ſize, upon the dark ground above mentioned, made the moſt glorious contraſt imaginable, and the blaze of it reflected ſtrongly on the ſurface of the ſea, which was at that time perfectly ſmooth, added greatly to this ſublime view.

The liquid lava, mixed with ſtones and *ſcoriæ*, after having mounted, I verily believe, at the leaſt ten thouſand feet, was partly directed by the wind towards Ottaiano, and partly falling almoſt perpendicularly, ſtill red-hot and liquid, on Veſuvius, covered its whole cone, part of that of the mountain of Somma, and the valley between them. The falling matter being nearly as vivid and inflamed as that which was continually iſſuing freſh from the crater, formed with it one complete body of fire, which could not be leſs than two miles and a half in breadth, and of the extraordinary height above mentioned, caſting a heat to the diſtance of at leaſt ſix miles around it.

The bruſh wood on the mountain of Somma was ſoon in a blaze, which flame, being of a different tint from the deep red of the matter thrown out of the volcano, and from the ſilvery blue of the electrical fire, ſtill added to the contraſt of this moſt extraordinary ſcene.

The black cloud increaſing greatly once bent towards Naples, and ſeemed to threaten this fair city with ſpeedy deſtruction; for it was charged with electrical matter, which kept conſtantly darting about it in ſtrong and bright zig zags, juſt like thoſe deſcribed by PLINY the younger in his letter to TACITUS, and which accompanied the great eruption of Veſuvius that proved fatal to his uncle [k]. This volcanic lightning, however, as I particularly remarked, very rarely quitted the cloud, but uſually returned to the great column of fire towards the crater of the volcano from whence it originally came [l]. Once or twice, indeed, I ſaw this lightning (or *ferilli* as it is called here) fall on the top of Somma, and ſet fire to ſome dry graſs and buſhes [m].

Fortunately

(k) " Ab altero latere, nubes atra, et horrenda, ignei ſpiritus tortis vi " bratiſque diſcurſibus rupta, in longas flammarum figuras dehiſcebat; fulgoribus " illæ, et ſimiles et majores." PLIN. Epiſt.

(l) SORRENTINO mentions the like obſervation, which he made during an eruption of Veſuvius in 1707, when the ſame kind of black cloud bent over Naples; theſe are his words. " Alle ore 19. tutti i cittadini nelle oſcure tenebre " ſi trovarono in mezzo delle Saette, delle quali, alcune vedeanſi uſcir dalla for- " nace del Veſuvio, e ſcorrere fino al capo di Paufilipo, d'onde non paſſando " più inanzi fuor la nuvola delle ceneri, o divertirſi altronde, indietro per " l'iſteſſa linea tornarono a ſcopiar ſu la fornace, onde uſcirono: qual moto re- " trogrado mai hopotuto intendere."

(m) Some time after the eruption had ceaſed, the air continued greatly impregnated with electrical matter. The Duke of Cotrofiano, a Neapolitan nobleman (who, from his ſuperior knowledge in experimental philoſophy and

Fortunately for us the wind increaſing from the S.W. quarter, carried back the threatning cloud juſt as it had reached the city, and began to occaſion great alarm. All public diverſions ceaſed in an inſtant, and the theatres being ſhut, the doors of the churches were thrown open. Numerous proceſſions were formed in the ſtreets, and women and children, with diſhevelled heads, filled the air with their cries, inſiſting loudly upon the relics of St. Januarius being immediately oppoſed to the fury of the mountain: in ſhort, the populace of this great city began to diſplay its uſual extravagant mixture of riot and bigotry, and if ſome ſpeedy and well-timed precautions had not been taken, Naples would, perhaps, have been in more danger of ſuffering from the irregularities of its lower claſs of inhabitants than from the angry volcano.

But to return to my ſubject: after the column of fire had continued in full force near half an hour, the eruption ceaſed all at once, and Veſuvius remained ſullen and ſilent. After the dazzling light of the fiery fountain [n],

mechanics, does honour to his country) told me, that having, about half an hour after the great eruption had ceaſed, held a Leyden bottle, armed with a pointed wire, out of his window at Naples, it ſoon became conſiderably charged. Whilſt the eruption was in force, its appearance was too alarming to allow one to think of ſuch experiments.

(n) The light diffuſed by this huge column of fire was ſo ſtrong, that the moſt minute objects could be diſcerned clearly within the compaſs of ten miles or more round the mountain. Mr. MORRIS, an Engliſh gentleman, told me, that at Sorrento, which is twelve miles from Veſuvius, he read the title page of a book by that volcanic light.

all ſeemed dark and diſmal, except the cone of Veſuvius, which was covered with glowing cinders and *ſcoriæ*, from under which, at times, here and there, ſmall ſtreams of liquid lava eſcaped, and rolled down the ſteep ſides of the volcano. This ſcene put me in mind of MARTIAL's deſcription of Etna:

Cuncta jacent flammis, et triſti merſa favillâ.

In the parts of Naples neareſt Veſuvius, whilſt the eruption laſted, a mixed ſmell, like that of ſulphur, with the vapours of an iron foundery, was ſenſible; but nearer to the mountain that ſmell was very offenſive, as I have often found it in my viſits to Veſuvius during an eruption.

Thus, SIR, have I endeavoured to convey to you at leaſt a faint idea of a ſcene ſo glorious and ſublime as, perhaps, may have never before been viewed by human eyes, at leaſt in ſuch perfection.

I am ſenſible, from the traces of them I have obſerved in the volcanic ſtrata, which compoſe the greateſt part of this country, that there have been many more conſiderable eruptions than the one juſt deſcribed; yet, moſt probably, thoſe very violent eruptions muſt either have been attended with earthquakes, and other ſuch alarming circumſtances, as to make the beholders leſs attentive to the beauty of the ſcenes ſuch phenomena offered than to

their own ſafety; or clouds of ſmoke and aſhes, as is uſually the caſe in all great eruptions, muſt have ſo far obſcured the volcano, as to exhibit only a confuſed maſs of fire and ſmoke.

Whilſt we had been enjoying the extraordinary ſight of this gigantic fountain of liquid fire in perfect ſafety, the unfortunate inhabitants of the other ſide of the mountain of Somma, particularly at Ottaiano and Cacciabella, were involved in that dark and ſooty cloud which formed ſo proper a back ground to our bright picture, and were pelted with ſtones and *ſcoriæ* of lava; but I ſhall preſently give you a particular deſcription of their truly diſtreſsful ſituations, juſt as I had it from many of the poor ſufferers themſelves, when I viſited that part of the country a few days after this eruption.

Monday, Auguſt the 9th, about nine o'clock in the morning, the fourth fever-fit of the mountain began to manifeſt itſelf by the uſual ſymptoms, ſuch as a ſubterraneous boiling noiſe, violent exploſions of inflamed matter from the crater of the volcano, accompanied with ſmoke and aſhes, which ſymptoms increaſed every inſtant. The ſmoke was of two ſorts; the one as white as ſnow, and the other as black as jet.

The white, as deſcribed in the former part of this journal, rolled gently maſs over maſs, reſembling bales of

of the ſofteſt cotton; and the black compoſed of *ſcoriæ* and minute aſhes ſhot up with force in the midſt of the white ſmoke, which, from the minerals, was alſo ſometimes tinged with yellow, blue, and green. Preſently ſuch a tremenduous maſs of theſe accumulated clouds ſtood over Veſuvius as ſeemed to threaten Naples again, and actually made the mountain itſelf appear a mole-hill.

This day's eruption was ſimilar to that of Thurſday laſt, but many degrees more violent. Some ſtones, thrown near as high as thoſe of laſt night, fell on the mountain of Somma, and ſet fire to the bruſh wood with which it is covered; but there being little wind, and that Weſterly, the volcanic matter roſe and fell in a more perpendicular direction, and Ottaiano did not ſuffer by this day's eruption; but moſt of the inhabitants of the towns, on the borders of Veſuvius, fled to Naples, alarmed by the tremendous clouds and the loud exploſions.

We remarked, that ſeveral very large ſtones, after having mounted to an immenſe height, formed a parabola, leaving behind them a trace of white ſmoke that marked their courſe; ſome burſt in the air exactly like bombs, and others fell into the valley between Somma and Veſuvius without burſting; others again burſt into a thou-

a thouſand pieces ſoon after their emiſſion from the crater: they might very properly be called volcanic bombs.

In the ſmoke iſſuing from the crater of Veſuvius we often remarked a ſudden briſk and quivering motion, which ſeemed to communicate itſelf inſtantaneouſly from one cloud to another, and ſometimes affected thoſe that were very high in the great maſs above the volcano. Though I could not diſcern any electrical fire, yet I make no doubt, but that the effect above mentioned was occaſioned by it, and would have been viſible in the night-time.

Upon the whole, this day's eruption was very alarming; until the lava broke out about two o'clock, and ran three miles between the two mountains, we were in continual apprehenſion of ſome fatal event. It continued to run about three hours, during which time every other ſymptom of the mountain fever gradually abated, and at ſeven o'clock at night all was calm.

It was univerſally remarked, that the air this night, for many hours after the eruption, was filled with meteors, ſuch as are vulgarly called falling ſtars; they ſhot generally in an horizontal direction, leaving a luminous trace behind them, but which quickly diſappeared. The night was remarkably fine, ſtar-light, and without a cloud. This kind of electrical fire ſeemed to be harmleſs,

leſs, and never to reach the ground; whereas that with which the black volcanic cloud of laſt night was pregnant appeared miſchievous, like the lightning that attends a ſevere thunder ſtorm, as we ſhould undoubtedly have experienced, had the eruption continued longer, and the cloud ſpread over Naples. The ſame kind of lightning proved fatal to ſeveral people, and did great damage within the ſpace of many miles round Veſuvius during its great eruption of 1631, as is mentioned in one of my former letters on this ſubject.

During this day's eruption the relics of St. Januarius were carried in proceſſion, and expoſed to the furious mountain from the bridge of the Maddalena, amidſt a prodigious concourſe of people, who are at this moment well convinced, that to this ceremony alone Naples may attribute its happy eſcape.

It was from their Sicilian Majeſties palace at Pauſilipo that I made my obſervations on this day's eruption, and in the preſence of their Majeſties, who had been pleaſed to ſend for me in the morning, as ſoon as the volcano became turbulent.

Tueſday, Auguſt the 10th, Veſuvius was quiet.

Wedneſday, Auguſt the 11th, about ſix o'clock in the morning, the fifth and laſt fever-fit of the mountain came on, and gradually increaſed. About twelve o'clock

it

it was at its height (o), and very violent indeed, the explo-ſions being louder than thoſe that attended the former eruptions, we could not judge of the height of the vol-lies of ſtones and *ſcoriæ*, as ſome rainy clouds were blended with the volcanic ones, and hid the upper part of the cone and crater of Veſuvius from our view.

The ſame mountains of white cotton-like clouds, piled one over another, roſe to ſuch an extraordinary height, and formed ſuch a coloſſal maſs over Veſuvius, as cannot poſſibly be deſcribed, or ſcarcely imagined. It may have been from a ſcene of this kind, that the ancient poets took their ideas of the giants waging war with Jupiter.

About five o'clock in the evening the eruption ceaſed, ſome rain having fallen this day, which having been greatly impregnated with the corroſive ſalts of the vol-cano, did much damage to the vines in its neighbour-hood.

Thurſday and Friday, the 12th and 13th of Auguſt, Veſuvius continued to ſmoke conſiderably, and at times ſlight exploſions were heard, like cannon at a great diſ-tance; but there have been no more throws from its cra-

(o) It has been remarked by the oldeſt people in the neighbourhood of Veſu-vius, that in its eruptions the volcano is ſubject to a criſis at noon and midnight; and, indeed, from my own obſervation, I believe that remark to be well-founded.

ter, nor any ſtreams of lava from its flanks, ſince Wedneſday laſt.

On Saturday, Auguſt the 15th, I went, accompanied by Count LAMBERG, the Imperial Miniſter at this Court, to viſit Ottaiano and Caccia-bella, the diſtrict which had been moſt ſeverely treated by the heavy and deſtructive ſhower of volcanic matter from the crater of Veſuvius laſt Sunday night.

Soon after having paſſed the town of Somma, we began to perceive, that the heat of the fiery ſhower, which had fallen in its neighbourhood, had affected the leaves of the trees and vines, which we found ſtill more parched and ſhrivelled in proportion as we approached the town of Ottaiano, which may be about three miles from Somma. At about the diſtance of a mile from Somma, we began to perceive freſh cinders or *ſcoriæ* of lava, thinly ſcattered on the road and in the fields. Every ſtep we advanced we found them of a larger dimenſion, and in greater abundance. At the diſtance of a mile and a half from Ottaiano, the ſoil was totally covered by them, and the leaves and fruit were either intirely ſtripped from the trees, or remained thinly on them, ſhrivelled and dried up by the intenſe heat of the volcanic ſhower.

After having paſſed through the moſt fertile country, abounding with trees loaded with fruits of every kind, and the moſt luxuriant vegetation, through gay villages crouded with chearful inhabitants, to come at once to ſuch a ſcene of deſolation and miſery, affording to our view nothing but heaps of black cinders and aſhes, blaſted trees, ruined houſes, with a few of their ſcattered inhabitants juſt returned with ghaſtly, diſmayed countenances, to ſurvey the havock done to their tenements and habitations, and from which they themſelves had with much difficulty eſcaped alive on Sunday laſt, was ſuch a melancholy ſcene as can neither be deſcribed or forgotten.

We found the roof of his Sicilian Majeſty's ſporting ſeat at Caccia-bella much damaged by the fall of large ſtones and heavy *ſcoriæ*, ſome of which, after having been broken by their fall through the roof, ſtill weighed upwards of thirty pounds. This place, in a direct line, cannot be leſs than four miles from the crater of Veſuvius.

The moſt authentic accounts have been received of the fall of ſmall volcanic ſtones and cinders (ſome of which weighed two ounces) at Benevento, Foggia, and Monte Mileto, upwards of thirty miles from Veſu-

vius [p]; but what is moſt extraordinary (as there was but little wind during the eruption of the eighth of Auguſt) minute aſhes fell thick that very night upon the town of Manfredonia, which is at the diſtance of an hundred miles from Veſuvius [q].

Theſe facts ſeem to confirm the extreme ſuppoſed height of the column of fire that iſſued from the crater of Veſuvius laſt Sunday night, and are greatly in ſupport of what we find recorded in the hiſtory of Veſuvius with reſpect to the fall of its aſhes at an amazing diſtance, and in a ſhort ſpace of time, during its violent eruptions.

We proceeeded from Caccia-bella to Ottaiano, which is a mile nearer to Veſuvius, and is reckoned to contain twelve thouſand inhabitants. Nothing could be more diſmal than the ſight of this town, unroofed, half buried

(p) The prince of Monte Mileto told me, that his ſon, the Duke of Popoli, who was at Monte Mileto the 8th of Auguſt, had been alarmed by the ſhower of cinders that fell there, ſome of which he had ſent to Naples, weighing two ounces; and that ſtones of an ounce had fallen upon an eſtate of his ten miles farther off. Monte Mileto is about thirty miles from the volcano.

(q) The Abbé GALIANI, well known in the literary world, told me, that his ſiſter, a nun in a Convent at Manfredonia, had wrote to enquire after him, imagining that Naples muſt have been deſtroyed, when they, at ſo great a diſtance, had been ſo much alarmed by a ſhower of minute aſhes, which fell on that city at eleven o'clock at night, the 8th of Auguſt, as to open all the churches, and go to prayers. As the great eruption happened at nine o'clock at night, the aſhes muſt have travelled an hundred miles within the ſhort ſpace of two hours.

under

under black *ſcoriæ* and aſhes, all the windows towards the mountain broken, and ſome of the houſes themſelves burnt, the ſtreets choaked up with theſe aſhes (in ſome that were narrow, the *ſtratum* was not leſs than four feet thick), and a few of the inhabitants juſt returned were employed in clearing them away, and piling up the aſhes in hillocks to get at their ruined houſes. Others were aſſembled in little groups, inquiring after their friends and neighbours, relating each other's woes, croſſing themſelves, and lifting up their eyes to Heaven when they mentioned their miraculous eſcapes. Some monks, who were in their convent during the whole of the horrid ſhower, gave us the following particulars, which they related with ſolemnity and preciſion.

The mountain of Somma, at the foot of which Ottaiano is ſituated, hides Veſuvius from its ſight, ſo that till the eruption became conſiderable it was not viſible to them. On Sunday night, when the noiſe increaſed, and the fire began to appear above the mountain of Somma, many of the inhabitants of this town flew to the churches, and others were preparing to quit the town, when a ſudden violent report was heard; ſoon after which they found themſelves involved in a thick cloud of ſmoke and minute aſhes: a horrid claſhing noiſe was heard in the air, and preſently fell a deluge of ſtones and

lar-

large *ſcoriæ*, ſome of which *ſcoriæ* were of the diameter of ſeven or eight feet, and muſt have weighed more than an hundred pounds before they were broken by their fall, as ſome of the fragments of them, which I picked up in the ſtreets, ſtill weighed upwards of ſixty pounds. When theſe large vitrified maſſes either ſtruck againſt one another in the air, or fell on the ground, they broke in many pieces, and covered a large ſpace around them with vivid ſparks of fire, which communicated their heat to every thing that was combuſtible (r). In an inſtant the town, and country about it, was on fire in many parts; for in the vineyards there were ſeveral ſtraw huts, which had been erected for the watchmen of the grapes, all of which were burnt. A great magazine of wood in the heart of the town was all in a blaze, and, had there been much wind, the flames muſt have ſpread univerſally, and all the inhabitants would have infallibly been burnt in their houſes, for it was impoſſible for them to ſtir out. Some who attempted it with pillows, tables, chairs, the tops of wine caſks, &c. on their heads, were either knocked down, or ſoon driven back to their cloſe quarters under arches, and in the cellars of their houſes. Many

(r) Theſe maſſes were formed of the liquid lava, the exterior parts of which had become black and porous by cooling in the long traverſe they had made through the air, whilſt the interior parts, leſs expoſed, retained an extreme heat, and were perfectly red.

were

were wounded, but only two perſons have died of the wounds they received from this dreadful volcanic ſhower. To add to the horror of the ſcene, inceſſant volcanic lightning was whiſking about the black cloud that ſurrounded them, and the ſulphureous ſmell and heat would ſcarcely allow them to draw their breath.

In this miſerable and alarming ſituation they remained about twenty-five minutes, when the volcanic ſtorm ceaſed all at once, and the frightened inhabitants of Ottaiano, apprehending a freſh attack from the turbulent mountain, haſtily quitted the country, after having depoſited the ſick and bed-ridden, at their own deſire, in the churches.

Had the eruption laſted an hour longer, Ottaiano muſt have remained exactly in the ſtate of Pompeia, which was buried under the aſhes of Veſuvius juſt 1700 years ago, with moſt of its inhabitants, whoſe bones are to this day frequently found under arches and in the cellars of the houſes of that ancient city.

We were told of many miracles that had been wrought by the images of ſaints at this place during the late diſaſter; but, as they are quite foreign to my purpoſe, I ſhall, as uſual, paſs them over in ſilence.

The palace of the Prince of Ottaiano is ſituated on an eminence above the town, and nearer the mountain, the

ſteps

ſteps leading up to it, being deeply covered with volcanic matter, reſembled the cone of Veſuvius, and the white marble ſtatues on the baluſtrade made a ſingular appearance peeping from under the black aſhes, which had entirely covered both the baluſtrade and their pedeſtals. The roof of the palace was totally deſtroyed, and the windows were broken; but the houſe itſelf, being ſtrongly built, had not ſuffered much.

We had an opportunity of ſeeing here exactly the quality of the dreadful ſhower, as the volcanic matter, which broke through the roof of the palace, and fell into the garrets on the balconies and in the courts, had not been removed. It was compoſed of the *ſcoriæ* of freſh lava much vitrified, great and ſmall, mixed with fragments of ancient ſolid lavas of different ſorts: many pieces were enveloped by the new lava, which formed a cruſt about them; and others were only ſlightly varniſhed by the freſh lava. Theſe kind of ſtones being very compact, and ſome weighing eight or ten pounds, muſt have fallen with greater force than the heavier *ſcoriæ*, which were very porous, and had the great ſurface above mentioned.

The palace of Ottaiano is built on a thick *ſtratum* of ancient lava, which ran from the mountain of Somma when in its active volcanic ſtate. Under this *ſtratum* we were

were ſhewn three grottoes, from which iſſues a conſtant extreme cold wind, and at times with impetuoſity, and a noiſe like water daſhing upon rocks. They are ſhut up with doors like cellars, and are made uſe of as ſuch, as alſo to keep proviſions freſh and to cool liquors. I had never ſeen theſe *ventaroli* before. In my letter to Dr. MATY, upon the nature of the ſoil round Naples, I have mentioned others of the ſame kind that I had met with on Veſuvius, Etna, and in the Iſland of Iſchia (*s*).

We obſerved, that the tract of country completely covered with a *ſtratum* of the volcanic matter above mentioned was about two miles and a half broad, and as much in length, in which ſpace the vines and fruit trees were totally ſtripped of their leaves and fruit, and had the appearance of being quite burnt up; but, to my great ſurprize, having viſited that country again two days ago, I ſaw thoſe very trees, which were apple, pear, peach, and apricot, in bloſſom again, and ſome with the fruit already formed, and of the ſize of hazel-nuts. The vines there had alſo put forth freſh leaves, and were in

(*s*) At Ceſi, in the Roman State, towards the Adriatic, there are many ſuch *ventaroli*; and the inhabitants of that town, by means of leaden pipes, conduct the freſh air from them into the very rooms of their houſes, ſo that by turning a cock they can cool them to any degree. Some who have refined ſtill more upon this luxury, by ſmaller pipes, bring this cold air under the dining table, ſo as to cool the bottle of liquor upon it.

bloom. Many foxes, hares, and other game, were deſtroyed by the fiery ſhower in the diſtrict of Somma and Ottaiano (1)

His Sicilian Majeſty, whoſe goodneſs of heart inclines him on all occaſions to ſhew his benevolence and aſſiſt the unfortunate, has ordered a conſiderable ſum of money to be diſtributed among the unhappy ſufferers of Ottaiano and its neighbourhood.

On the 18th of September I went upon Mount Veſuvius, accompanied by Lord HERBERT and my uſual guide. We could not poſſibly reach its crater, being covered with a thick ſmoke, too ſulphureous and offenſive to be encountered; neither would it have been prudent to have ventured up, had there not been that impediment, as it was evident, from the loud reports we heard from time to time, that there exiſted ſtill a great fermentation within the bowels of the volcano. We therefore contented ourſelves with examining the effects of the late extraordinary eruption on its cone, and in the valley between it and the mountain of Somma.

The conical part of Veſuvius is now covered with fragments of lava and *ſcoriæ*, which makes the aſcent

(1) Having had the honour of being on a ſhooting party lately with the King of Naples, at the foot of Veſuvius and Somma, ſeveral dead hares were found, and we killed others whoſe backs were quite bare, the fur having been ſinged off of them by the hot aſhes.

much

much more difficult and troubleſome than when it was only covered with minute aſhes. The particularity of this laſt eruption was, that the lava which uſually ran out of the flanks of the volcano, forming caſcades, rivers, and rivulets of liquid fire, was now chiefly thrown up from its crater in the form of a gigantic fountain of fire [u], which falling ſtill in ſome degree of fuſion has, in a manner,

(u) SORRENTINO mentions, in his Iſtoria del Veſuvio, that the volcano in 1676 vented itſelf in the like manner. "Non a torrenti modo mandò fuori le "ſue viſcere, ma tutti in aria menòlla." Such wonderful, violent, and ſudden emiſſions of liquid lava muſt have been occaſioned by ſome accidental and extraordinary cauſe; and I was inclined to think, that a ſudden communication of water with the lava in fuſion might be the occaſion of ſuch a phenomenon, particularly as we know that pools of rain-water have been found formerly in caverns within the bowels of Veſuvius; and that a river, ſuppoſed to be that anciently called Draco, and which was buried by an ancient eruption, burſt out ſome years ago with ſuch force, from under a *ſtratum* of lava at Torre del Greco, as to be ſufficient to turn mills there; but a late curious experiment, mentioned by Monſ. DE FAUJAS, in his Recherches ſur les Volcans éteints, p. 176. ſeems to contradict my ſuppoſition; and that water introduced to the furnace of a volcano, finding there a more rarified air, would not produce an exploſion. Monſ. DESLAUDES, Director of the Royal Manufacture of Looking-glaſs at St. Gobin, made the following experiment in 1768, in the preſence of the Duke DE LA ROCHEFOUCAULT, Monſ. DE FAUJAS, and others. He poured ſome water upon a quantity of glaſs in fuſion, and which had been in that ſtate in the crucible for twelve hours. The water did not occaſion the leaſt fermentation; but, on the contrary, rolled upon its ſurface, without even producing any ſmoke, and after having become ſeemingly red-hot, like the metal in fuſion, diſappeared in about three minutes, without having occaſioned the leaſt exploſion. If the great emiſſions of lava above mentioned were not then occaſioned by water mixing with the lava, may not they have been produced by violent

a manner, caſed up the conical part of Veſuvius with a *ſtratum* of hard *ſcoriæ:* on the ſide next the mountain of Somma, that *ſtratum* is ſurely more than one hundred feet thick, forming a high ridge. The valley between Veſuvius and Somma has received ſuch a prodigious quantity of lava and other volcanic matter during this laſt eruption, that it is raiſed, as is imagined, two hundred and fifty feet or more. Three ſuch eruptions as the laſt would completely fill up the valley, and, by uniting Veſuvius and Somma, form them into one mountain, as they moſt probably were before the great eruption in the reign of TITUS. In ſhort, I found the whole face of Veſuvius changed. Thoſe curious channels, in which the lava ran in the month of May laſt, are all buried. The volcano appears to have likewiſe increaſed in height; the form of the crater is changed, a great piece of its rim towards Somma being wanting; and on the ſide towards the ſea it is alſo broken. There are ſome very large cracks towards the point of the cone of the volcano, which makes it probable, that more of the borders of the crater will fall in. The ridge of freſh volcanic matter on the cone of Veſuvius towards Somma, and the thick *ſtratum* in the valley, are likewiſe

ſubterraneous exhalations having forced their way into the cauldron of the volcano (if I may be allowed the expreſſion) replete with matter in fuſion, and blown its whole contents, with what even oppoſed its paſſage, at once into the air?

full

full of cracks, from which there iſſues a conſtant ſulphureous ſmoke that tinges them and the circumjacent *ſcoriæ* and cinders with a deep yellow, or ſometimes a white tint. Theſe laſt mentioned cracks, though deep, do not, as I apprehend, paſs the *ſtratum* formed by the laſt eruption, and which, from its extreme thickneſs, particularly in the valley, will probably retain a great degree of heat for ſome years to come, as did a thick *ſtratum* of lava that ran into the *foſſa grande* in the year 1767.

The number and ſize of the ſtones, or, more properly ſpeaking, of the fragments of lava which have been thrown out of the volcano in the courſe of the laſt eruption, and which lie ſcattered thick on the cone of Veſuvius, and at the foot of it, is really incredible. The largeſt we meaſured was in circumference no leſs than one hundred and eight Engliſh feet, and ſeventeen feet high. It is a ſolid block, and is much vitrified: in ſome parts of it there are large pieces of pure glaſs, of a brown yellow colour, like that of which our common bottles are made, and throughout its pores ſeem to be filled with perfect vitrifications of the ſame ſort. The ſpot where it alighted is plainly marked by a deep impreſſion almoſt at the foot of the cone of the volcano, and it took three bounds before it ſettled, as is plainly perceived by the marks

marks it has left on the ground, and by the ſtones which it has pounded to atoms under its prodigious weight. When we conſider the enormous ſize and weight of ſuch a ſolid maſs, thrown at leaſt a quarter of a mile clear of the mouth of the volcano, we can but admire the wonderful powers of nature, of which, being ſo very ſeldom within the reach of human inſpection, we are in general too apt to judge upon much too ſmall a ſcale.

Another ſolid block of ancient lava, ſixty-ſix feet in circumference, and nineteen feet high, being nearly of a ſpherical ſhape, was thrown out at the ſame time, and lies near the former. This ſtone, which has the marks of having been rounded, nay almoſt poliſhed, by continual rolling in torrents, or on the ſea-ſhore, and which yet has been ſo undoubtedly thrown out of the volcano, may be the ſubject of curious ſpeculations (*x*). Another block of ſolid lava that was thrown much farther, and lies in the valley between the cone of Veſuvius and the Hermitage, is ſixteen feet high, and ninety-two feet in circumference, though it plainly appears, by the large fragments that lie round, and were detached from it by the ſhock

(*x*) Or may not this ſtone be a ſpherical volcanic baſalt, ſuch as one of forty-five feet in circumference, deſcribed by Monſ. FAUJAS DE ST. FOND, in p. 155. of his curious book on the ſubject of extinguiſhed volcanos?

of

of its fall, that it muſt have been twice as conſiderable when in the air.

There are thouſands of very large fragments of different ſpecies of ancient and modern lavas, that lie ſcattered by the late exploſions on the cone of Veſuvius, and in the vallies at its foot; but theſe three were the largeſt of thoſe we meaſured (y).

We found alſo many fragments of thoſe volcanic bombs that burſt in the air, as mentioned in the former part of this journal; and ſome entire, having fallen to the ground without burſting. The freſh red-hot and liquid lava having been thrown up with numberleſs fragments of ancient lavas, the latter were often cloſely enveloped by the former; and probably when ſuch fragments of lava were porous and full of air bubbles, as is often the caſe, the extreme outward heat, ſuddenly rarifying the confined air, cauſed an exploſion. When theſe fragments were of a more compact lava they did not explode, but were ſimply incloſed by the freſh lava, and acquired a ſpherical form by whirling in the air, or rolling down the ſteep ſides of the volcano.

(y) We meaſured two other ſtones in the valley between Somma and Veſuvius; the one was twenty-two feet and a half long, thirteen feet and a half broad, and ten feet high; the other, eleven feet and a half high, and ſeventy-two feet in circumference.

The ſhell or outward coat of the bombs that burſt, and of which we found ſeveral pieces, was always compoſed of freſh lava, in which many ſplinters of the more ancient lava that had been incloſed are ſeen ſticking. I was much pleaſed with this diſcovery, having been greatly puzzled for an explanation of this volcanic operation, which was new to me, and which was very frequent during the eruption of the 9th of Auguſt.

The phenomenon of the natural ſpun-glaſs, which fell at Ottaiano with the aſhes on the 5th of Auguſt, was likewiſe clearly explained to me here. I have already mentioned, that the lava thrown up by this eruption was in general more perfectly vitrified than that of any former eruption, which appeared plainly upon a nearer examination of the fragments of freſh lava, the pores of which we generally found full of a pure vitrification, and the *ſcoriæ* themſelves, upon a cloſe examination with a magnifying glaſs, appeared like a confuſed heap of filaments of a foul vitrification. When a piece of the ſolid freſh lava had been cracked in its fall without ſeparating entirely, we always ſaw capillary fibres of perfect glaſs, reaching from ſide to ſide within the cracks. If I may be allowed a mean compariſon, which, however, conveys the idea of what I wiſh to explain better than any other I can think of, this lava reſembled a rich Parmeſan cheeſe,

cheeſe, which, when broken and gently ſeparated, ſpins out tranſparent filaments from the little cells that contained the clammy liquor of which thoſe filaments were compoſed. The natural ſpun-glaſs, then, that fell at Ottaiano during this eruption, as well as that which fell in the Iſle of Bourbon in the year 1766, muſt have been formed, moſt probably, by the operation of ſuch a ſort of lava as has been juſt deſcribed, cracking and ſeparating in the air at the time of its emiſſion from the craters of the volcanos, and by that means ſpinning out the pure vitrified matter from its pores or cells, the wind at the ſame time carrying off thoſe filaments of glaſs as faſt as they were produced.

I obſerved, ſticking to ſome very large fragments of the new lava, which were of a cloſe grain, ſome pieces of a ſubſtance, whoſe texture very much reſembled that of a true pumice ſtone; and, upon a cloſe examination, and having ſeparated them from the lava, I perceived, that this ſubſtance had actually been forced out of the minute pores of the ſolid ſtone itſelf, and was a collection of fine vitreous fibres or filaments, confounded together at the time of their being preſſed out by the contraction of the large fragments of lava in cooling, and which had bent downwards by their own weight. This curious ſubſtance has the lightneſs of a

pumice, and reſembles it in every reſpect except being of a darker colour.

When the pores of the freſh ſolid lava were large and filled with pure vitrified matter, we found that matter ſometimes blown into bubbles on its ſurface, I ſuppoſe, by the air which had been forced out at the time the lava contracted itſelf in cooling: thoſe bubbles, being thin, ſhewed that this volcanic glaſs has the kind of tranſparency of our common glaſs bottles, and is like them of a dirty yellow colour. I detached with a hammer ſome large pieces of this kind of glaſs as big as my fiſt, which adhered to, and was incorporated with, ſome of the larger fragments of lava, and, though of the ſame kind, from their thickneſs they appeared perfectly black, and were opaque.

Another particularity is remarkable in the lava of this eruption: many detached pieces of it are in the ſhape of a barley-corn or of a plumb-ſtone, ſmall at each end, and thick in the middle. We picked up ſeveral, and ſaw many more which were too heavy for us to carry off, for they muſt have weighed more than ſixty pounds; ſome of the ſmaller ones did not weigh an ounce. I ſuppoſe them to be drops from the liquid fountain of fire of the 8th of Auguſt, which might very naturally acquire ſuch a form in their fall; but the peaſants in the neighbourhood

bourhood of Vesuvius are well convinced that they are the thunder-bolts that fell with the volcanic lightning.

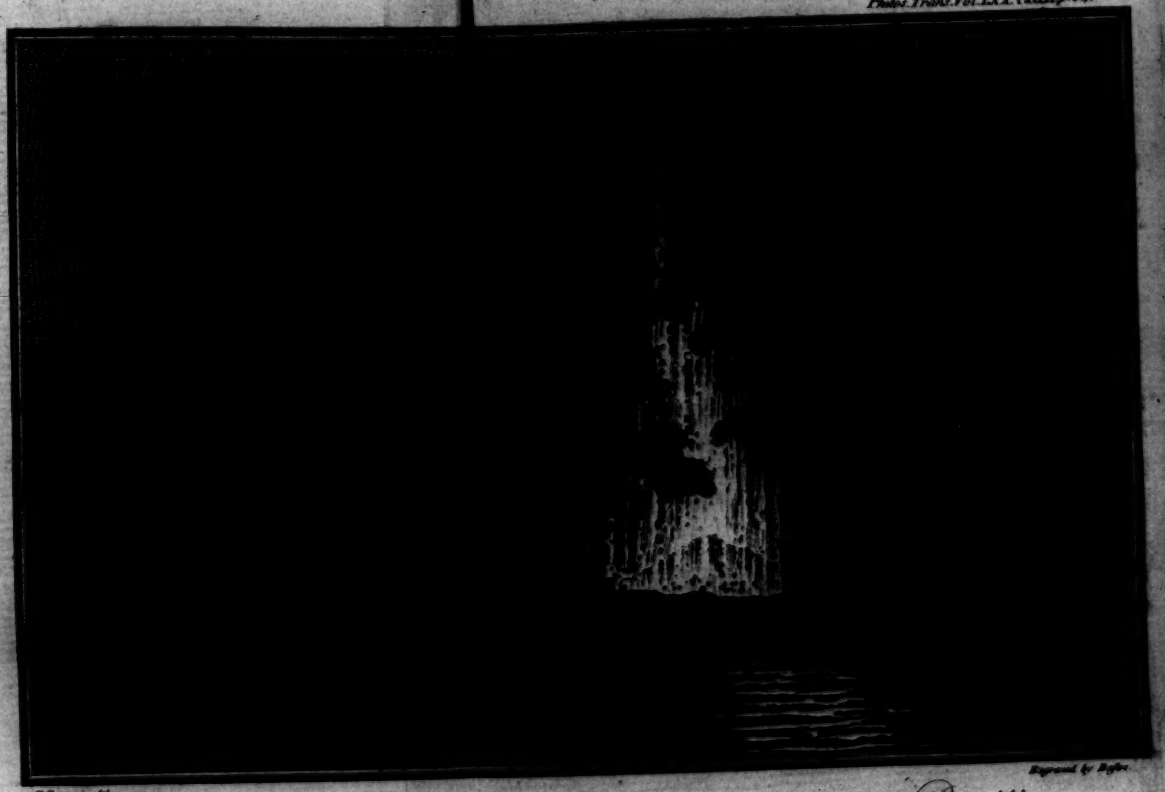
We found many of the volcanic bombs or, properly speaking, round balls of fresh lava, large and small; all of which have a *nucleus* composed of a fragment of more ancient and solid lava. There were also some other curious vitrifications, very different from any I had ever seen before, mixed with the late fallen shower of huge *scoriæ* and masses of lava.

Though I have endeavoured to be as particular and clear as possible in the description I have given of the curious substances produced by the late eruption of Vesuvius, yet, as specimens of those substances will explain more at one sight than I can pretend to do by whole pages in writing, I shall not fail to send you, by the first favourable opportunity, a collection of them, which I have set apart for that purpose, particularly as, I flatter myself, they may serve to give some light into a hitherto obscure subject: I mean, the nature and manner of the formation of pumice-stones.

Vesuvius continues to smoke considerably, and we had a slight shock of an earthquake yesterday; so that I do not think, notwithstanding the late eruptions having been so very considerable, that the volcano has vented itself so sufficiently as to remain long quiet.

I muſt now, SIR, beg your pardon if I have treſpaſſed too much upon your time: I meant to be ſhort, clear, and explicit; and if, by aiming at the two latter, I have failed in the former, I hope I ſhall be excuſed, and that you will pleaſe to take the will for the deed.

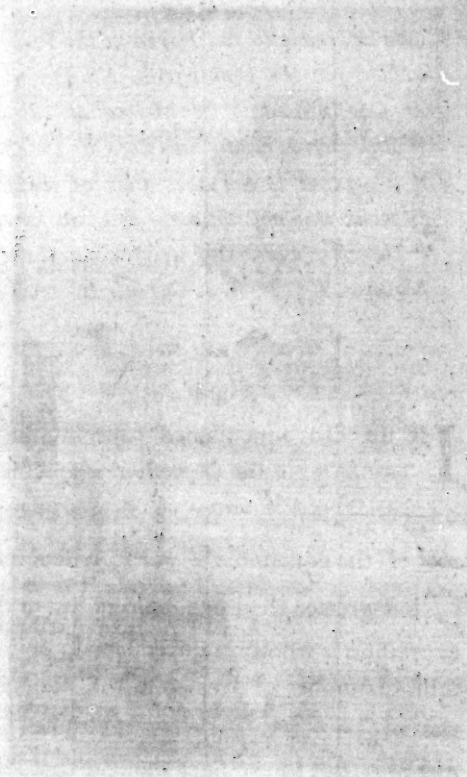
I am, &c.



P. Fergola del.

Engraved by Byrne

View of the Eruption of M. Vesuvius, Aug.st 8.th 1779 from Pausilipo.



V. *An Appendix to the Paper in the Philoſophical Tranſactions for the Year* 1778, *Number* XLII, *pages* 902 *et ſeq. intitled,* "*A Method of extending* Cardan's "*Rule for reſolving one Caſe of the Cubick Equation* "$x^3-qx=r$ *to the other Caſe of the ſame Equation,* "*which it is not naturally fitted to ſolve, and which is* "*therefore called* the irreducible Caſe." *By* Francis Maſeres, *Eſq. F. R. S. Curſitor Baron of the Exchequer.*

Read Nov. 4, 1779.

ARTICLE I.

IN the above-mentioned paper in the Philoſophical Tranſactions the expreſſion $\sqrt[3]{e}\times$ the infinite ſeries $2+\frac{2ii}{9ee}-\frac{20i^4}{243e^4}+\frac{308i^6}{6561e^6}-$ &c. is ſhewn to be equal to the root of the equation $x^3-qx=r$, whenever $\frac{rr}{4}$ is leſs than $\frac{q^3}{27}$, but greater than one half of it, or than $\frac{q^3}{54}$. This expreſſion is wholly tranſcendental, or compoſed of an infinite number of terms, to wit, the terms of the ſeries $2+\frac{2ii}{9ee}-\frac{20i^4}{243e^4}+\frac{308i^6}{6561e^6}-$ &c. multiplied into the cube-root of e. But I have ſince thought that it might be convenient on ſome occaſions to divide this expreſſion, if poſſible, into two others, whereof the one ſhould be a

mere algebraick expreſſion, or conſiſt of a finite number of terms, and the other ſhould be tranſcendental, or involve in it an infinite ſeries. And I have accordingly diſcovered a method of doing this, which I will now proceed to deſcribe.

ART. 2. In the above-mentioned paper in the Philoſophical Tranſactions I denoted the exceſs of $\frac{q^3}{27}$ above $\frac{rr}{4}$ in the ſecond caſe of the equation $x^3 - qx = r$, as well as the exceſs of $\frac{rr}{4}$ above $\frac{q^3}{27}$ in the firſt caſe of it, by the letters ss. But I have ſince thought that it might have been better to denote the exceſs of $\frac{q^3}{27}$ above $\frac{rr}{4}$ in the ſecond caſe of that equation by the letters zz, in order the more clearly to diſtinguiſh it from the oppoſite difference $\frac{rr}{4} - \frac{q^3}{27}$ in the firſt caſe of it, which was denoted by ss. And I therefore in the courſe of the following pages ſhall uſe the letters zz inſtead of ss to denote the ſaid exceſs of $\frac{q^3}{27}$ above $\frac{rr}{4}$ in the ſecond caſe of the ſaid equation, or the difference $\frac{q^3}{27} - \frac{rr}{4}$.

ART. 3. Now, if zz be ſubſtituted inſtead of ss in the expreſſion $\sqrt[3]{e} \times$ the infinite ſeries $2 + \frac{2ss}{9ee} - \frac{20s^4}{243e^4} + \frac{308s^6}{6561e^6} -$ &c. that expreſſion will thereby be converted into the following expreſſion, to wit, $\sqrt[3]{e} \times$ the infinite ſeries $2 + \frac{2zz}{9ee} - \frac{20z^4}{243e^4} + \frac{308z^6}{6561e^6} -$ &c. Therefore, if $\frac{rr}{4}$ be

leſs

leſs than $\frac{q^3}{27}$ but greater than $\frac{q^3}{54}$, and e be put $= \frac{r}{2}$, and zz be put $= \frac{q^3}{27} - \frac{rr}{4}$, the root of the equation $x^3 - qx = r$ will be equal to $\sqrt[3]{e} \times$ the infinite ſeries $2 + \frac{2zz}{9e} - \frac{20z^4}{243e^4} + \frac{308z^6}{6561e^6}$ – &c.

ART. 4. The numeral coefficients $\frac{2}{9}$, $\frac{20}{243}$, $\frac{308}{6561}$, &c. of $\frac{zz}{ee}$, $\frac{z^4}{e^4}$, $\frac{z^6}{e^6}$, &c. in this ſeries are exactly double of $\frac{1}{9}$, $\frac{10}{243}$, $\frac{154}{6561}$, &c. which are the numeral coefficients of the ſame powers of the fraction $\frac{z}{e}$ in the ſeries $1 + \frac{z}{3e} - \frac{zz}{9ee} + \frac{5z^3}{81e^3} - \frac{10z^4}{243e^4} + \frac{22z^5}{729e^5} - \frac{154z^6}{6561e^6} + \frac{2618z^7}{137,781e^7}$ – &c. which is equal to the cube-root of the binomial quantity $1 + \frac{z}{e}$; or, if the numeral coefficients of the ſaid latter ſeries be denoted by the capital letters A, B, C, D, E, F, G, H, &c. reſpectively, ſo that A ſhall be $= 1$, $B = \frac{1}{3}$, $C = \frac{1}{9}$, $D = \frac{5}{81}$, $E = \frac{10}{243}$, $F = \frac{22}{729}$, $G = \frac{154}{6561}$, and $H = \frac{2618}{137,781}$, and ſo on, the ſaid numeral coefficients $\frac{2}{9}$, $\frac{20}{243}$, $\frac{308}{6561}$, &c. will be equal to 2C, 2E, 2G, &c. and the ſeries mentioned in the laſt Article will be $2A + \frac{2Czz}{ee} - \frac{2Ez^4}{e^4} + \frac{2Gz^6}{e^6}$ – &c. and conſequently the root of the equation $x^3 - qx = r$, in the ſecond caſe of it, in which $\frac{rr}{4}$ is leſs than $\frac{q^3}{27}$, will be equal to the expreſſion $\sqrt[3]{e} \times$ the ſeries $2A + \frac{2Czz}{ee} - \frac{2Ez^4}{e^4} + \frac{2Gz^6}{e^6}$ – &c.

ART. 5. Now the ſeries $2A + \frac{2Czz}{ee} - \frac{2Ez^4}{e^4} + \frac{2Gz^6}{e^6}$ – &c.

is

is equal to the sum of the two following series, to wit, $2A - \frac{2Czz}{ee} - \frac{2Ez^4}{e^4} - \frac{2Gz^6}{e^6}$ – &c. (in which all the terms following the first term are marked with the sign –, or are subtracted from the first term), and $\frac{4Czz}{ee} + \frac{4Gz^6}{e^6}$ + &c; and the series $2A - \frac{2Czz}{ee} - \frac{2Ez^4}{e^4} - \frac{2Gz^6}{e^6}$ – &c. is equal to the sum of the two series $A + \frac{Bz}{e} - \frac{Czz}{ee} + \frac{Dz^3}{e^3} - \frac{Ez^4}{e^4} + \frac{Fz^5}{e^5} - \frac{Gz^6}{e^6}$ + &c. and $A - \frac{Bz}{e} - \frac{Czz}{ee} - \frac{Dz^3}{e^3} - \frac{Ez^4}{e^4} - \frac{Fz^5}{e^5} - \frac{Gz^6}{e^6}$ – &c. which are respectively equal to the cube-roots of the binomial quantities $1 + \frac{z}{e}$ and $1 - \frac{z}{e}$. Therefore the series $2A + \frac{2Czz}{ee} - \frac{2Ez^4}{e^4} + \frac{2Gz^6}{e^6}$ – &c. is $= \sqrt[3]{1 + \frac{z}{e}} + \sqrt[3]{1 - \frac{z}{e}}$ + the infinite series $\frac{4Czz}{ee} + \frac{4Gz^6}{e^6}$ + &c. Consequently the expression $\sqrt[3]{e} \times$ the series $2A + \frac{2Czz}{ee} - \frac{2Ez^4}{e^4} + \frac{2Gz^6}{e^6}$ – &c. is $= \sqrt[3]{e} \times \sqrt[3]{1 + \frac{z}{e}} + \sqrt[3]{e} \times \sqrt[3]{1 - \frac{z}{e}} + \sqrt[3]{e} \times$ the infinite series $\frac{4Czz}{ee} + \frac{4Gz^6}{e^6}$ + &c. $= \sqrt[3]{e + z} + \sqrt[3]{e - z} + \sqrt[3]{e} \times$ the infinite series $\frac{4Czz}{ee} + \frac{4Gz^6}{e^6}$ + &c. $= \sqrt[3]{e + z} + \sqrt[3]{e - z} + 4\sqrt[3]{e} \times$ the series $\frac{Czz}{ee} + \frac{Gz^6}{e^6} + \frac{Lz^{10}}{e^{10}} + \frac{Pz^{14}}{e^{14}} + \frac{Tz^{18}}{e^{18}}$ + &c. Therefore the root of the equation $x^3 - qx = r$, in the second case of it, in which $\frac{rr}{4}$ is less than $\frac{q^3}{27}$, is equal to $\sqrt[3]{e + z} + \sqrt[3]{e - z} + 4\sqrt[3]{e} \times$ the series $\frac{Czz}{ee} + \frac{Gz^6}{e^6} + \frac{Lz^{10}}{e^{10}} + \frac{Pz^{14}}{e^{14}} + \frac{Tz^{18}}{e^{18}}$ + &c; of which expression the first part, to wit,

wit, $\sqrt[3]{e+z} + \sqrt[3]{e-z}$ is algebraick, and the latter part, to wit, $\sqrt[3]{e} \times$ the series $\frac{Czz}{ee} + \frac{Gz^6}{e^6} + \frac{Lz^{10}}{e^{10}} + \frac{Pz^{14}}{e^{14}} + \frac{Tz^{18}}{e^{18}} +$ &c. is transcendental. Q. E. I. (*a*)

Of the convergency of the Series obtained in the preceding Article.

ART. 6. This series $\frac{Czz}{ee} + \frac{Gz^6}{e^6} + \frac{Lz^{10}}{e^{10}} + \frac{Pz^{14}}{e^{14}} + \frac{Tz^{18}}{e^{18}} +$ &c. evidently converges faster than the series $2A + \frac{2Czz}{ee} - \frac{2Ez^4}{e^4} + \frac{2Gz^6}{e^6} -$ &c. or $2 + \frac{2zz}{9ee} - \frac{20z^4}{243e^4} + \frac{308z^6}{6561e^6} -$ &c: and consequently the expression $\sqrt[3]{e+z} + \sqrt[3]{e-z} + 4\sqrt[3]{e} \times$ the series $\frac{Czz}{ee} + \frac{Gz^6}{e^6} + \frac{Lz^{10}}{e^{10}} + \frac{Pz^{14}}{e^{14}} + \frac{Tz^{18}}{e^{18}} +$ &c. seems rather fitter

(*a*) N. B. I have been informed that both this mixed expression of the root of the equation $x^3 - gx = r$ in the second case of it, and the merely transcendental expression of it published in the former paper, and from which this expression is derived, were invented by Monsieur NICOLE, and published in the memoirs of the French Academy of Sciences so long ago as the year 1738; and the latter of them, to wit, the transcendental expression $\sqrt[3]{e} \times$ the series $2 + \frac{2zz}{9ee} - \frac{20z^4}{243e^4} + \frac{308z^6}{6561e^6} -$ &c. I had myself seen many years ago in Monsieur CLAIRAUT's algebra, in the place cited in the 50th Article of my former paper, to wit, in pages 286, 287, 288. But it was obtained by the intervention of negative quantities, and the roots of negative quantities, which gave it, in my opinion, an air of great obscurity. And therefore I thought an investigation of the same series, by a method that keeps clear of those difficulties, might not be unacceptable to the lovers of these sciences, nor unworthy of a place in the Transactions of this learned body.

to exhibit the value of x in the equation $x^3 - qx = r$, in the second case of it (in which $\frac{rr}{4}$ is less than $\frac{q^3}{27}$), to a considerable degree of exactness than the former expression $\sqrt[3]{e} \times$ the series $2 + \frac{2zz}{9e} - \frac{20z^4}{243e^2} + \frac{308z^6}{6561e^3} -$ &c.

A Computation of the four first Terms of the Series obtained in Art. 5.

Art. 7. The first fifteen terms of the infinite series which is equal to the cube-root of $1 + \frac{z}{e}$ are as follows; to wit, $1 + \frac{z}{3e} - \frac{zz}{9ee} + \frac{5z^3}{81e^3} - \frac{10z^4}{243e^4} + \frac{22z^5}{729e^5} - \frac{154z^6}{6561e^6} + \frac{2618z^7}{137,781e^7} - \frac{935z^8}{59,049e^8} + \frac{21505z^9}{1,594,323e^9} - \frac{55913z^{10}}{4,782,969e^{10}} + \frac{147,407z^{11}}{14,348,907e^{11}} - \frac{1,179,256z^{12}}{129,140,163e^{12}} + \frac{3,174,920z^{13}}{387,420,489e^{13}} - \frac{60,323,480z^{14}}{8,135,830,269e^{14}}$ + &c; or, in decimal fractions, $1 +$ .333,333,333, &c. $\times \frac{z}{e} -$ .111,111,111, &c. $\times \frac{zz}{ee} +$ .061,728,395, &c. $\times \frac{z^3}{e^3} -$ .041,152,263, &c. $\times \frac{z^4}{e^4} +$ .030,178,326, &c. $\times \frac{z^5}{e^5} -$ .023,472,031, &c. $\times \frac{z^6}{e^6} +$ .019,001,167, &c. $\times \frac{z^7}{e^7} -$ .015,834,305, &c. $\times \frac{z^8}{e^8} +$ .013,488,482, &c. $\times \frac{z^9}{e^9} -$ .011,690,017, &c. $\times \frac{z^{10}}{e^{10}} +$ .010,273,045, &c. $\times \frac{z^{11}}{e^{11}} -$ .009,131,595, &c. $\times \frac{z^{12}}{e^{12}} +$ .008,195,021, &c. $\times \frac{z^{13}}{e^{13}} -$ .007,414,542, &c. $\times \frac{z^{14}}{e^{14}}$. Therefore the four first terms of the series $\frac{Czz}{ee} + \frac{Gz^9}{e^9} +$

$\frac{Lz^{10}}{e^{10}}$

$\frac{Lz^{11}}{e^{11}}+\frac{Pz^{14}}{e^{14}}+\frac{Tz^{17}}{e^{17}}$ + &c. are $\frac{zz}{9ee}+\frac{154z^6}{6561e^6}+\frac{5591,53z^{10}}{4,782,969e^{10}}+\frac{60,323,480z^{14}}{8,135,830,269e^{14}}$,

or, in decimal fractions, .111,111,111, &c. $\times \frac{zz}{ee}$ + .023,472,031, &c. $\times \frac{z^6}{e^6}$ + .011,690,017, &c. $\times \frac{z^{10}}{e^{10}}$ + .007,414,542, &c. $\times \frac{z^{14}}{e^{14}}$. Therefore the root of the cubick equation $x^3-qx=r$, in the second case of it (in which $\frac{rr}{4}$ is less than $\frac{q^3}{27}$), is equal to $\sqrt[3]{e+z}+\sqrt[3]{e-z}+4\sqrt[3]{e}\times$ the series $\frac{zz}{9ee}+\frac{154z^6}{6561e^6}+\frac{55,913z^{10}}{4,782,969e^{10}}+\frac{60,323,480z^{14}}{8,135,830,269e^{14}}$ + &c. *ad infinitum*, or $\sqrt[3]{e+z}+\sqrt[3]{e-z}+4\sqrt[3]{e}\times$ the series .111,111,111, &c. $\times \frac{zz}{ee}$ + .023,472,031, &c. $\times \frac{z^6}{e^6}$ + .011,690,017, &c. $\times \frac{z^{10}}{e^{10}}$ + .007,414,542, &c. $\times \frac{z^{14}}{e^{14}}$ + &c. *ad infinitum*.

Of the best Manner of Proceeding to the Computation of more Terms of the said Series, if required.

ART. 8. If more than four terms of this last series are required, it will be necessary to compute the series $1+\frac{z}{3e}-\frac{zz}{9ee}+\frac{5z^3}{81e^3}-\frac{10z^4}{243e^4}+\frac{22z^5}{729e^5}-\frac{154z^6}{6561e^6}$ + &c. (which is $=\sqrt[3]{1+\frac{z}{e}}$), to more than fifteen terms; in order to which it will be convenient to express the terms of that series in the following manner, to wit, $1+\frac{1}{3}\times\frac{Az}{e}-\frac{2}{6}\times\frac{Bzz}{ee}+\frac{5}{9}\times\frac{Cz^3}{e^3}-\frac{8}{24}\times$ $\frac{Dz^4}{e^4}+\frac{11}{15}\times\frac{Ez^5}{e^5}-\frac{14}{18}\times\frac{Fz^6}{e^6}+\frac{17}{21}\times\frac{Gz^7}{e^7}-\frac{20}{24}\times\frac{Hz^8}{e^8}+\frac{23}{27}\times\frac{Iz^9}{e^9}-\frac{26}{30}\times\frac{Kz^{10}}{e^{10}}+\frac{29}{33}\times$

$\frac{Lz^{11}}{e^{11}} - \frac{32}{36} \times \frac{Mz^{12}}{e^{12}} + \frac{35}{39} \times \frac{Nz^{13}}{e^{13}} - \frac{38}{42} \times \frac{Oz^{14}}{e^{14}} + \frac{41}{45} \times \frac{Pz^{15}}{e^{15}} - \frac{44}{48} \times \frac{Qz^{16}}{e^{16}} + \frac{47}{51} \times$
$\frac{Rz^{17}}{e^{17}} - \frac{50}{54} \times \frac{Sz^{18}}{e^{18}} + \frac{53}{57} \times \frac{Tz^{19}}{e^{19}} - \frac{56}{60} \times \frac{Vz^{20}}{e^{20}} + \frac{59}{63} \times \frac{Wz^{21}}{e^{21}} - \frac{62}{66} \times \frac{Xz^{22}}{e^{22}} +$ &c. or

$A + \frac{Bz}{e} - \frac{Czz}{ee} + \frac{Dz^3}{e^3} - \frac{Ez^4}{e^4} + \frac{Fz^5}{e^5} - \frac{Gz^6}{e^6} + \frac{Hz^7}{e^7} - \frac{Iz^8}{e^8} + \frac{Kz^9}{e^9} - \frac{Lz^{10}}{e^{10}} + \frac{Mz^{11}}{e^{11}} - \frac{N^{12}}{e^{12}} +$
$\frac{Oz^{13}}{e^{13}} - \frac{Pz^{14}}{e^{14}} + \frac{41}{45} \times \frac{Pz^{15}}{e^{15}} - \frac{44}{48} \times \frac{Qz^{16}}{e^{16}} + \frac{47}{51} \times \frac{Rz^{17}}{e^{17}} - \frac{50}{54} \times \frac{Sz^{18}}{e^{18}} + \frac{53}{57} \times \frac{Tz^{19}}{e^{19}} - \frac{56}{60} \times$
$\frac{Vz^{20}}{e^{20}} + \frac{59}{63} \times \frac{Wz^{21}}{e^{21}} - \frac{62}{66} \times \frac{Xz^{22}}{e^{22}} +$ &c; in which it is evident that the generating fractions of the coefficients of the several terms are derived from those that immediately precede them by the continual addition of the number 3 to both their numerators and denominators.

An example of the resolution of a cubick equation by means of the expression $\sqrt[3]{e+z} + \sqrt[3]{e-z} + 4\sqrt[3]{e} \times$ *the series* $\frac{Czz}{ee} + \frac{Gz^6}{e^6} + \frac{Lz^{10}}{e^{10}} + \frac{Pz^{14}}{e^{14}} + \frac{Tz^{18}}{e^{18}} +$ *&c. given in Art.* 5.

ART. 9. Let it be required to resolve the equation $x^3 - x = \frac{1}{3}$ by means of the said expression.

Here q is $= 1$, and $r = \frac{1}{3}$; and consequently q^3 is $= 1$, and $\frac{q^3}{27} = \frac{1}{27}$, and $\frac{r}{2} = \frac{1}{6}$, and $\frac{rr}{4} = \frac{1}{36}$, which is less than $\frac{1}{27}$, or $\frac{q^3}{27}$. Therefore this equation does not come under CARDAN's rule, but may be resolved by the expression given in Art. 5, provided that $\frac{rr}{4}$, though less than $\frac{q^3}{27}$, is greater than half $\frac{q^3}{27}$, or than $\frac{q^3}{54}$; which it is, because

it is $=\frac{1}{36}$, whereas $\frac{q^3}{54}$ is equal only to $\frac{1}{54}$, which is leſs than $\frac{1}{36}$. Therefore the propoſed equation $x^3-x=\frac{1}{3}$ may be reſolved by means of the ſaid expreſſion.

ART. 10. Now, ſince in this caſe q is $=1$, and r is $=\frac{1}{3}$, we ſhall have $\frac{r}{2}$, or e, $=\frac{1}{6}$, and $\frac{q^3}{27}-\frac{rr}{4}$ $(=\frac{1}{27}-\frac{1}{36}=\frac{4}{108}-\frac{3}{108}=\frac{1}{108})=\frac{1}{36\times 3}$; that is, zz will be $=\frac{1}{36\times 3}$, and conſequently z will be $=\frac{1}{6\sqrt{3}}$. Therefore $e+z$ will be $=\frac{1}{6}+\frac{1}{6\sqrt{3}}$ $(=\frac{\sqrt{3}}{6\sqrt{3}}+\frac{1}{6\sqrt{3}}=\frac{3}{6\times 3}+\frac{\sqrt{3}}{6\times 3}=\frac{3+\sqrt{3}}{6\times 3}=\frac{3+\sqrt{3}}{18}=\frac{3+1.732,050,8}{18}=\frac{4.732,050,8}{18})=.262,891,71$; and $e-z$ will be $=\frac{1}{6}-\frac{1}{6\sqrt{3}}$ $(=\frac{3-\sqrt{3}}{18}=\frac{3-1.732,050,8}{18}=\frac{1.267,949,2}{18})=.070,441,62$. Therefore the cube-root of $e+z$ is $=\sqrt[3]{.262,891,71}=.640,607,91$; and the cube-root of $e-z$ is $=\sqrt[3]{.070,441,62}=.412,993,40$; and conſequently $\sqrt[3]{e+z}+\sqrt[3]{e-z}$ is $=.640,607,91+.412,993,40=1.053,601,31$.

ART. 11. It remains that we compute the infinite ſeries $\frac{Czz}{ee}+\frac{Gz^6}{e^6}+\frac{Lz^{10}}{e^{10}}+\frac{Pz^{14}}{e^{14}}+\frac{Tz^{18}}{e^{18}}+$ &c. and extract the cube-root of e, and then multiply the ſaid ſeries into 4 times the ſaid cube-root.

Now the cube-root of e is in this caſe $=\sqrt[3]{\frac{1}{6}}=\frac{1}{\sqrt[3]{6}}=\frac{1}{1,817,121}$; and conſequently $4\sqrt[3]{e}$ is $=\frac{4}{1,817,121}$.

And,

And, since zz is $= \frac{1}{36 \times 3}$, and ee is $= \frac{4}{36}$, it follows that $\frac{zz}{ee}$ will be $= \frac{1}{3}$. Therefore $\frac{z^4}{e^4}$ will be $= \frac{1}{9}$, and $\frac{z^6}{e^6} = \frac{1}{27}$, and $\frac{z^{10}}{e^{10}}$ $(= \frac{z^6}{e^6} \times \frac{z^4}{e^4} = \frac{1}{27} \times \frac{1}{9}) = \frac{1}{243}$, and $\frac{z^{14}}{e^{14}}$ $(= \frac{z^{10}}{e^{10}} \times \frac{z^4}{e^4} = \frac{1}{243} \times \frac{1}{9}) = \frac{1}{2187}$. Therefore the series $\frac{Czz}{ee} + \frac{Gz^6}{e^6} + \frac{Lz^{10}}{e^{10}} + \frac{Pz^{14}}{e^{14}}$ + &c. will in this case be $= \frac{C}{3} + \frac{G}{27} + \frac{L}{243} + \frac{P}{2187}$ + &c. $= \frac{.111,111,111,\text{ &c.}}{3} +$ $\frac{.023,472,031,\text{ &c.}}{27} + \frac{.011,690,017,\text{ &c.}}{243} + \frac{.007,414,542,\text{ &c.}}{2187}$ + &c. $=$ .037,037,037,&c. + .000,869,334,&c. + 000,048,107, &c. + 000,003,390, &c. + &c. $=$ .037,957,868, &c.

Therefore $4\sqrt[3]{e} \times$ the series $\frac{Czz}{ee} + \frac{Gz^6}{e^6} + \frac{Lz^{10}}{e^{10}} + \frac{Pz^{14}}{e^{14}}$ + &c. is equal to $\frac{4}{1.817,121} \times .037,957,868,\text{ &c.} = \frac{.151,831,472,\text{ &c.}}{1.817,121} =$ .083,556,06.

Consequently the whole expression $\sqrt[3]{e+z} + \sqrt[3]{e-z} +$ $4\sqrt[3]{e} \times$ the series $\frac{Czz}{ee} + \frac{Gz^6}{e^6} + \frac{Lz^{10}}{e^{10}} + \frac{Pz^{14}}{e^{14}}$ + &c. is $=$ 1.053,601,31 + .083,556,06 $=$ 1.137,157,37; that is, the root of the proposed equation $x^3 - x = \frac{1}{3}$ is $=$ 1.137,157,37. Q. E. I.

Art. 12. This value of the root of the equation $x^3 - x = \frac{1}{3}$ is exact to six places of figures, the more accurate value of it being 1.137,158,164. We may therefore conclude that the expression here made use of to determine the value of x, to wit, $\sqrt[3]{e+z} + \sqrt[3]{e-z} +$ $4\sqrt[3]{e} \times$

$4\sqrt[3]{e} \times$ the infinite series $\frac{Cxx}{ee} + \frac{Gx^6}{e^6} + \frac{Lx^{10}}{e^{10}} + \frac{Px^{14}}{e^{14}}$ + &c. is somewhat preferable, with respect to the practical resolution of these equations, to the other expression of its value given in the former paper in the Philosophical Transactions, to wit, $\sqrt[3]{e} \times$ the infinite series $2 + \frac{2xx}{9ee} - \frac{20x^4}{243e^4} + \frac{308x^6}{6561e^6}$ – &c. For it appeared in Art. 42 of that paper, page 941, that the value of the root of this same equation $x^3 - x = \frac{1}{3}$ obtained by computing four terms of the series $2 + \frac{2xx}{9ee} - \frac{20x^4}{243e^4} + \frac{308x^6}{6561e^6}$ – &c. was 1.137,33; which is true only to four places of figures; whereas by computing the same number of terms of the series $\frac{Cxx}{ee} + \frac{Gx^6}{e^6} + \frac{Lx^{10}}{e^{10}} + \frac{Px^{14}}{e^{14}}$ + &c. we have just now obtained a value of the same root, to wit, the number 1,137,157,37, which is exact to six places of figures. This is agreeable to what was observed above in Art. 6.

A Summary of the Conclusions obtained in this Paper and the former Paper to which it is an Appendix.

ART. 13. I will now conclude this paper by setting down, in as concise a manner as I can, the several conclusions that have been obtained in this and the above-mentioned paper in the Philosophical Tranfactions for the

the year 1778, Number XLII. page 902, &c. concerning the root of the cubick equation $x^3-qx=r$, that the whole may be ſeen together at one view.

ART. 14. If $\frac{rr}{4}$ is greater than $\frac{q^3}{27}$, and e be put $=\frac{r}{2}$, and $ss=\frac{rr}{4}-\frac{q^3}{27}$, it is ſhewn in Art. 5, of the ſaid former paper, that the root of the equation $x^3-qx=r$ will be $=\sqrt[3]{\frac{r}{2}+\sqrt{\frac{rr}{4}-\frac{q^3}{27}}}\ \frac{+q}{3\sqrt[3]{\frac{r}{2}+\sqrt{\frac{rr}{4}-\frac{q^3}{27}}}}$, or $\sqrt[3]{e+s}+\frac{q}{3\sqrt[3]{e+s}}$.

ART. 15. And it is ſhewn in Art. 9. of the ſaid paper, that the root of the ſaid equation will in that caſe be alſo equal to $\sqrt[3]{\frac{r}{2}-\sqrt{\frac{rr}{4}-\frac{q^3}{27}}}\ \frac{q}{3\sqrt[3]{\frac{r}{2}-\sqrt{\frac{rr}{4}-\frac{q^3}{27}}}}$, or $\sqrt[3]{e-s}+\frac{q}{3\sqrt[3]{e-s}}$.

ART. 16. And it is ſhewn in Art. 11, of the ſaid paper, page 915, that the root of the ſaid equation will in that caſe be alſo equal to $\sqrt[3]{\frac{r}{2}+\sqrt{\frac{rr}{4}-\frac{q^3}{27}}}+\sqrt[3]{\frac{r}{2}-\sqrt{\frac{rr}{4}-\frac{q^3}{27}}}$, or $\sqrt[3]{e+s}+\sqrt[3]{e-s}$.

ART. 17. And it is ſhewn in Art. 23, of the ſaid paper, page 923, that the root of the ſaid equation will in that caſe be alſo equal to $\sqrt[3]{e}$ x the infinite ſeries

$$2-\frac{2s}{9e}-\frac{2s^4}{243e^4}-\frac{308s^8}{6561e^8}-\frac{1870s^{12}}{59049e^{12}}-\frac{111,826s^{16}}{4,782,969e^{16}}-\frac{2,358,512s^{20}}{129,140,163e^{20}}-\frac{120,646,960s^{24}}{8,135,830,269e^{24}}-$$

$\frac{120,646,960s^{14}}{8,135,830,269e^{14}}$ – &c. or (if we put the capital letters A, B, C, D, E, F, G, H, &c. for the ſeveral numeral coefficients 1, $\frac{1}{3}$, $\frac{1}{9}$, $\frac{5}{81}$, $\frac{10}{243}$, $\frac{22}{729}$, $\frac{154}{6561}$, $\frac{2618}{137,781}$, &c. of the terms of the ſeries $1+\frac{s}{3e}-\frac{ss}{9ee}+\frac{5s^3}{81e^3}-\frac{10s^4}{243e^4}+\frac{22s^5}{729e^5}-\frac{154s^6}{6561e^6}+\frac{2618s^7}{137,781e^7}$ – &c. which is equal to the cube-root of the binomial quantity $1+\frac{s}{e}$), equal to $\sqrt[3]{e}\times$ the infinite ſeries $2A-\frac{2Css}{ee}-\frac{2Es^4}{e^4}-\frac{2Gs^6}{e^6}-\frac{2Is^8}{e^8}-\frac{2Ls^{10}}{e^{10}}-\frac{2Ns^{12}}{e^{12}}-\frac{2Ps^{14}}{e^{14}}$ – &c; in which ſeries all the terms after the firſt term 2A, or 2, are marked with the ſign –, or are to be ſubtracted from the ſaid firſt term.

ART. 18. And, if $\frac{rr}{4}$ is leſs than $\frac{q^3}{27}$, but greater than its half, or $\frac{q^3}{54}$, and e be put, as before, $=\frac{r}{2}$, and $zz=\frac{q^3}{27}-\frac{rr}{4}$, it is ſhewn in Art. 31, 32, 33, 34, 35, of the ſaid paper, pages 927—936, that the root of the equation $x^3-qx=r$ will be equal to $\sqrt[3]{e}\times$ the infinite ſeries $2+\frac{2zz}{9ee}-\frac{20z^4}{243e^4}+\frac{308z^6}{6561e^6}-\frac{1870z^8}{59049e^8}+\frac{111,826z^{10}}{4,782,969e^{10}}-\frac{2,358,512z^{12}}{129,140,163e^{12}}+\frac{120,646,960z^{14}}{8,135,830,269e^{14}}$ – &c. or $\sqrt[3]{e}\times$ the infinite ſeries $2A+\frac{2Czz}{ee}-\frac{2Ez^4}{e^4}+\frac{2Gz^6}{e^6}-\frac{2Iz^8}{e^8}+\frac{2Lz^{10}}{e^{10}}-\frac{2Nz^{12}}{e^{12}}+\frac{2Pz^{14}}{e^{14}}-\frac{2Rz^{16}}{e^{16}}+\frac{2Tz^{18}}{e^{18}}$ – &c; in which ſeries the capital letters A, C, E, G, I, L, N, P, R, T, &c. denote the ſame numeral coefficients 1, $\frac{1}{9}$, $\frac{10}{243}$, $\frac{154}{6561}$, &c. as in the laſt Article, and all the terms that involve the

odd powers of the fraction $\frac{zz}{ee}$, to wit, $\frac{zz}{ee}$ itſelf, $\frac{zz}{ee}\Big|^3$, or $\frac{z^6}{e^6}$, $\frac{zz}{ee}\Big|^5$, or $\frac{z^{10}}{e^{10}}$, $\frac{zz}{ee}\Big|^7$, or $\frac{z^{14}}{e^{14}}$, $\frac{zz}{ee}\Big|^9$, or $\frac{z^{18}}{e^{18}}$, &c. are marked with the ſign +, or are to be added to the firſt term 2A, or 2, and all the other terms are marked with the ſign −, or are to be ſubtracted from the former.

Theſe are the concluſions obtained in the ſaid former paper, which is printed in the Philoſophical Tranſactions for the year 1778, Number XLII. pages 902—949. The concluſions obtained in this paper are as follows.

ART. 19. If $\frac{rr}{4}$ is leſs than $\frac{q^3}{27}$, but greater than its half, or $\frac{q^3}{54}$, and e be put, as before, $=\frac{r}{2}$, and $zz=\frac{q^3}{27}-\frac{rr}{4}$, it is ſhewn in the preſent paper, Art. 5 and 7, that the root of the equation $x^3-qx=r$ will be equal to the mixed expreſſion $\sqrt[3]{e+z}+\sqrt[3]{e-z}+4\sqrt[3]{e}\times$ the infinite ſeries $\frac{zz}{9ee}+\frac{154z^6}{6561e^6}+\frac{559132^{10}}{4,782,969e^{10}}+\frac{60,323,480z^{14}}{8,135,830,269e^{14}}$ + &c. or $\sqrt[3]{e+z}+\sqrt[3]{e-z}+4\sqrt[3]{e}\times$ the infinite ſeries .111,111,111, &c. $\times\frac{zz}{ee}+.023,472,031$, &c. $\times\frac{z^6}{e^6}+.011,690,017$, &c. $\times\frac{z^{10}}{e^{10}}+$ .007,414,542, &c. $\times\frac{z^{14}}{e^{14}}$ + &c. or $\sqrt[3]{e+z}+\sqrt[3]{e-z}+4\sqrt[3]{e}\times$ the infinite ſeries $\frac{Czz}{ee}+\frac{Gz^6}{e^6}+\frac{Lz^{10}}{e^{10}}+\frac{Pz^{14}}{e^{14}}$ + &c; in which ſeries the capital letters C, G, L, P, &c. denote the

ſame numeral coefficients $\frac{1}{9}$, $\frac{154}{6561}$, $\frac{55913}{4,782,969}$, $\frac{60,323,480}{8,135,830,269}$, &c. as they denoted in the two laſt Articles, to wit, the coefficients of $\frac{zz}{ee}$, $\frac{z^6}{e^6}$, $\frac{z^{10}}{e^{10}}$, $\frac{z^{14}}{e^{14}}$, $\frac{z^{18}}{e^{18}}$, &c. or of the odd powers of $\frac{zz}{ee}$ in the ſeries which is equal to $\sqrt[3]{1+\frac{z}{e}}$. And it is alſo ſhewn in Art. 6 and 12 of this paper, that this expreſſion, computed to a given number of terms, gives the value of x ſomewhat more exactly than the former expreſſion, $\sqrt[3]{e} \times$ the infinite ſeries $2+\frac{2zz}{9ee}-\frac{20z^4}{243e^4}+\frac{308z^6}{6561e^6}-$ &c. if computed only to the ſame number of terms.

ART. 20. As to the ſecond branch of the ſecond caſe of the equation $x^3-qx=r$, or that in which $\frac{rr}{4}$ is leſs than half $\frac{q^3}{27}$, or than $\frac{q^3}{54}$, I do not know any method of extending CARDAN'S rule to it. But I have been informed by my learned and ingenious friend Dr. CHARLES HUTTON, Profeſſor of Mathematicks in the Royal Academy at Woolwich, that he has diſcovered ſuch a method: and I hope he will ſoon communicate it to this learned Society.

VI. *An Account of a Method for the ſafe Removal of Ships that have been driven on Shore, and damaged in their Bottoms, to places (however diſtant) for repairing them. By Mr.* William Barnard, *Shipbuilder*, Grove Street, Deptford; *communicated by* Nevil Maſkelyne, *D. D. F. R. S. and Aſtronomer Royal.*

Read Dec. 23, 1779.

Deptford, April 14, 1779.

ON the ſhores of this Iſland, diſtinguiſhed for its formidable fleets and extenſive commerce, and ſo particularly ſituated, there muſt neceſſarily be many ſhipwrecks: every hint by which the diſtreſs of our fellow creatures may be alleviated, or any ſaving of property made to individuals in ſuch ſituations, ſhould be communicated for their good. As the members of the Royal Society have it in their power to make ſuch hints moſt univerſally known, I have been induced, from their readineſs to receive every uſeful information, to lay before them a particular account of the ſucceſs attending a method for the ſafe removal of ſhips that have been driven on ſhore,

ſhore, and damaged in their bottoms, to places (however diſtant) for repairing them; I hope, therefore, they will excuſe the liberty I have taken in preſenting this to them. Should the Society honour me by recording it, it will make me the moſt ample ſatisfaction for my attention to it, and afford me the greateſt pleaſure.

On January the 1ſt, 1779, in a moſt dreadful ſtorm, the York Eaſt Indiaman, of eight hundred tons, homeward bound, with a pepper cargo, parted her cables in Margate Roads, and was driven on ſhore, within one hundred feet of the head, and thirty feet of the ſide, of Margate Pier, then drawing twenty-two feet ſix inches water, the flow of a good ſpring tide being only fourteen feet at that place.

On the 3d of the ſame month I went down, as a ſhipbuilder, to aſſiſt as much as lay in my power my worthy friend Sir RICHARD HOTHAM, to whom the ſhip belonged. I found her perfectly upright, and her ſhere (or ſide appearance) the ſame as when firſt built, but ſunk to the twelve feet water mark fore and aft in a bed of chalk mixed with a ſtiff blue clay, exactly the ſhape of her body below that draft of water; and from the rudder being torn from her as ſhe ſtruck coming on ſhore, and the violent agitation of the ſea after her being there, her ſtern was ſo greatly injured as to admit free acceſs thereto,

which

which filled her for four days equal to the flow of the tide. Having fully informed myſelf of her ſituation and the flow of ſpring tides, and being clearly of opinion ſhe might be again got off, I recommended, as the firſt neceſſary ſtep, the immediate diſcharge of the cargo; and, in the progreſs of that buſineſs, I found the tide always flowed to the ſame height on the ſhip; and when the cargo was half diſcharged, and I knew the remaining part ſhould not make her draw more than eighteen feet water, and while I was obſerving the water at twenty-two feet ſix inches by the ſhip's marks, ſhe inſtantly lifted to ſeventeen feet eight inches, the water and air being before excluded by her preſſure on the clay, and the atmoſphere acting upon her upper part equal to ſix hundred tons, which is the weight of water diſplaced at the difference of thoſe two draughts of water.

The moment the ſhip lifted, I diſcovered ſhe had received more damage than was at firſt apprehended, her leaks being ſuch as filled her from four to eighteen feet water in one hour and a half. As nothing effectual was to be expected from pumping, ſeveral ſcuttles or holes in the ſhip's ſide were made, and valves fixed thereto, to draw off the water to the loweſt ebb of the tide, to facilitate the diſcharge of the remaining part of the cargo; and, after many attempts, I ſucceeded in an external applica-

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tion of ſheep ſkins ſewed on a ſail, and thruſt under the bottom, to ſtop the body of water from ruſhing ſo furiouſly into the ſhip. This buſineſs effected, moderate pumping enabled us to keep the ſhip to about ſix feet water at low water, and by a vigorous effort we could bring the ſhip ſo light as (when the cargo ſhould be all diſcharged) to be eaſily removed into deeper water. But as the external application might be diſturbed by ſo doing, or totally removed by the agitation of the ſhip, it was abſolutely neceſſary to provide ſome permanent ſecurity for the lives of thoſe who were to navigate her to the river Thames. I then recommended, as the cheapeſt, quickeſt, and moſt effectual plan, to lay a deck in the hold, as low as the water could be pumped to, framed ſo ſolidly and ſecurely, and caulked ſo tight as to ſwim the ſhip independant of her own leaky bottom. I herewith ſend you a drawing of the ſame, which will give the Society a clearer idea of the buſineſs than a long deſcription, which, however, it may be uſeful to add for the better enabling others to put this method in practice.

Beams of fir timber, twelve inches ſquare, were placed in the hold under every lower deck beam in the ſhip, as low as the water would permit; theſe were in two pieces, for the convenience of getting them down, and alſo for the better fixing them of an exact length, and well

bolted

bolted together when in their places. Over theſe were laid long Dantzic deals of two inches and an half thick, well nailed and caulked. Againſt the ſhip's ſide, all fore and aft, was well nailed a piece of fir, twelve inches broad and ſix inches thick on the lower, and three inches on the upper edge, to prevent the deck from riſing at the ſide. Over the deck, at every beam, was laid a croſs piece of fir timber, ſix inches deep and twelve inches broad, reaching from the pillar of the hold to the ſhip's ſide, on which the ſhores were to be placed to reſiſt the preſſure of the water beneath. On each of theſe, and againſt the lower deck beam, at equal diſtance from the ſide and middle of the ſhip, was placed an upright ſhore, ſix inches by twelve inches, the lower end let two inches into the croſs piece. From the foot of this ſhore to the ſhip's ſide, under the end of every lower deck beam, was placed a diagonal ſhore, ſix inches by twelve, to eaſe the ſhip's deck of part of the ſtrain by throwing it on the ſide. An upright ſhore, of three inches by twelve, was placed from the end of every croſs piece to the lower deck beams at the ſide; and one of three inches by twelve on the midſhip end of every croſs piece to the lower deck beam, and nailed to the pillars in the hold. Two firm tight bulkheads or partitions were made as near the extremes of the ſhip as poſſible. The cieling

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or inſide plank of the ſhip was very ſecurely caulked up to the lower deck, and the whole formed a compleat ſhip with a flat bottom within ſide to ſwim the outſide leaky one; and that bottom being depreſſed ſix feet below the external water, reſiſted the ſhip's weight above it, equal to five hundred and eighty-one tons, and ſafely conveyed her to the dry dock at Deptford.

Since I wrote the above account, I have been deſired to uſe the ſame method on a Swediſh ſhip, ſtranded near Margate on the ſame day as the York Eaſt India-man, and ſwim her to London. As this ſhip is about two hundred and fifty tons, and the execution of the buſineſs ſomething different from what was practiſed with regard to the large ſhip, I hope it will not be thought improper to deſcribe it.

As this ſhip's bottom was ſo much injured, having loſt eight feet of her ſtern-poſt and all her keel, ſeveral floor-timbers being broke, and ſome of the planks off her bottom, (ſo as to leave a hole big enough for a man to come through) ſeveral lower deck beams being likewiſe broke, and all the pillars in the hold broken and waſhed away; I thought it neceſſary to connect, in ſome degree, the ſhattered bottom with the ſhip's decks, not only to ſupport the temporary deck by which ſhe was to ſwim up, but to

prevent the bottom being cruſhed by the weight of the ſhip when ſhe was put upon blocks in the dry dock: to effect which, after I had put acroſs twelve beams of fir, ſix inches by twelve, edgeways, one under every lower deck beam of the ſhip, and well faſtened them to the ſhip's ſide, I placed two upright pieces to each beam of ſix inches by twelve, ſecurely bolted to the ſides of the keelſon, and ſcored ſix inches under the ſhip's lower deck beams, and three inches about the beams of the temporary deck, and well faſtened to each: then the deck was laid with long two-inch Dantzic deals, and well nailed and caulked; the ſhip's inſide plank was well caulked up to the lower deck. A piece of fir, of twelve inches broad and two inches thick on the upper, and four inches on the lower edge, was well nailed to the ſhip's ſide all fore and aft, and well caulked on both edges to prevent the ſide of the deck from leaking, or being forced up by the preſſure of the water againſt the deck, a two-inch deal or croſs piece was laid over every beam from the ſhip's ſide to the uprights at the middle line; then, at equal diſtance from the ſide and middle line, pieces of ſix inches ſquare, as long as could be got down, were put all fore and aft on both ſides, ſcored two inches over every croſs piece, and well bolted through the croſs piece and deck, and into the fir beams. From this fore and aft piece or ribband to the

ſhip's

ſhip's ſide, and from it to the uprights in the middle, were placed two rows of diagonal ſhores, ſix inches ſquare, the heels of which were ſecurely wedged againſt the fore and aft piece or ribband, which afforded ſufficient ſupport to the temporary deck without any other ſhores. Two bulkheads or partitions were built, as far as the fore-maſt forward, and mizen-maſt aft, well planked, ſhored, and caulked, to reſiſt the water. As decks laid in this manner, and in ſo much hurry as the time of low water requires, will of conſequence leak in ſome degree, and as that leakage, waſhing from ſide to ſide, will cauſe the ſhip to lay along, I fixed a two-inch deal, twelve inches broad, edgeways, all fore and aft at the middle line, and well caulked it, to ſtop half the water on the weather or upper ſide, when the ſhip would incline either way, which not only made her ſtiffer under ſail, but facilitated the pumping out the water made by leaks in the deck.

This deck was ſixty-three feet long and twenty-three feet broad, and was laid at five feet five inches above the bottom of the keel, or four feet above the top of the floor timbers, and ſwam the ſhip at twelve feet five inches water, reſiſting two hundred and ſixteen tons, and containing under it one hundred and twenty-four tons of water, which preſſing againſt the under ſide of the temporary

deck acted as ballaſt, and brought her ſafely into the dry dock at Deptford, from the moſt dangerous ſituation poſſible, being partly within and partly without Margate Pier, where ſhe had been left by ſome Ramſgate men, who had undertaken to remove her from the place where ſhe was ſtranded to a ſafer one within Margate Harbour.

REFERENCES,

A. Beams of Fir 12 inches square put across in halves with 12 feet scarph and bolted to each other and to the Ships side, one under every Lower deck Beam.

B. Ships Lower deck Beams.

C. Flat of the Deck laid with 2½ in. deals 36ft. long.

D. A piece of Fir 12 in.ᶜʰ broad & 6 in.ᶜʰ thick well nailed against the Ships side all fore & aft over the Deals to prevent the side of the Deck from rising.

E. Pillars in hold about which every half Beam was scored, and through which the middle bolt of the Beams was driven.

F. Cross pieces of Fir 12 in.ᶜʰ broad and 6 in.ᶜʰ thick placed over every Lower Beam from the pillar in the middle to the side, to prevent the nails drawing through the deals, & to place the Shores upon to support the Deck.

G. Shores 12 in.ᶜʰ by 6 in.ᶜʰ on every cross piece and let into them 2 in.ᶜʰ.

H. Diagonal shores from the foot of every upright shore G. to the Ships side, under every end of Lower deck Beams.

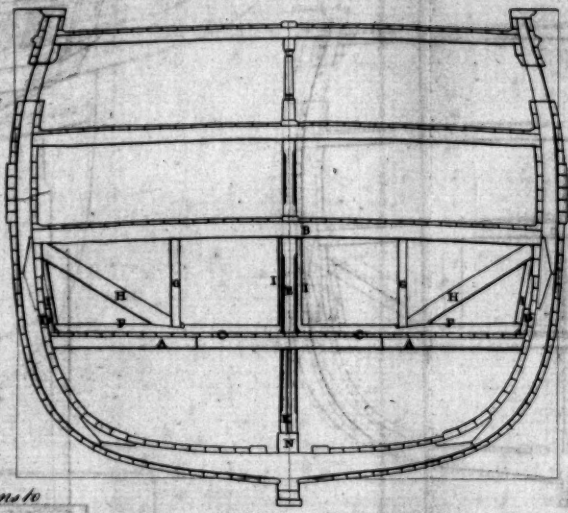
I. Shores of 12 in.ᶜʰ by 3 in.ᶜʰ from each end of the cross piece to the Lower deck Beams to keep the Cross piece from rising.

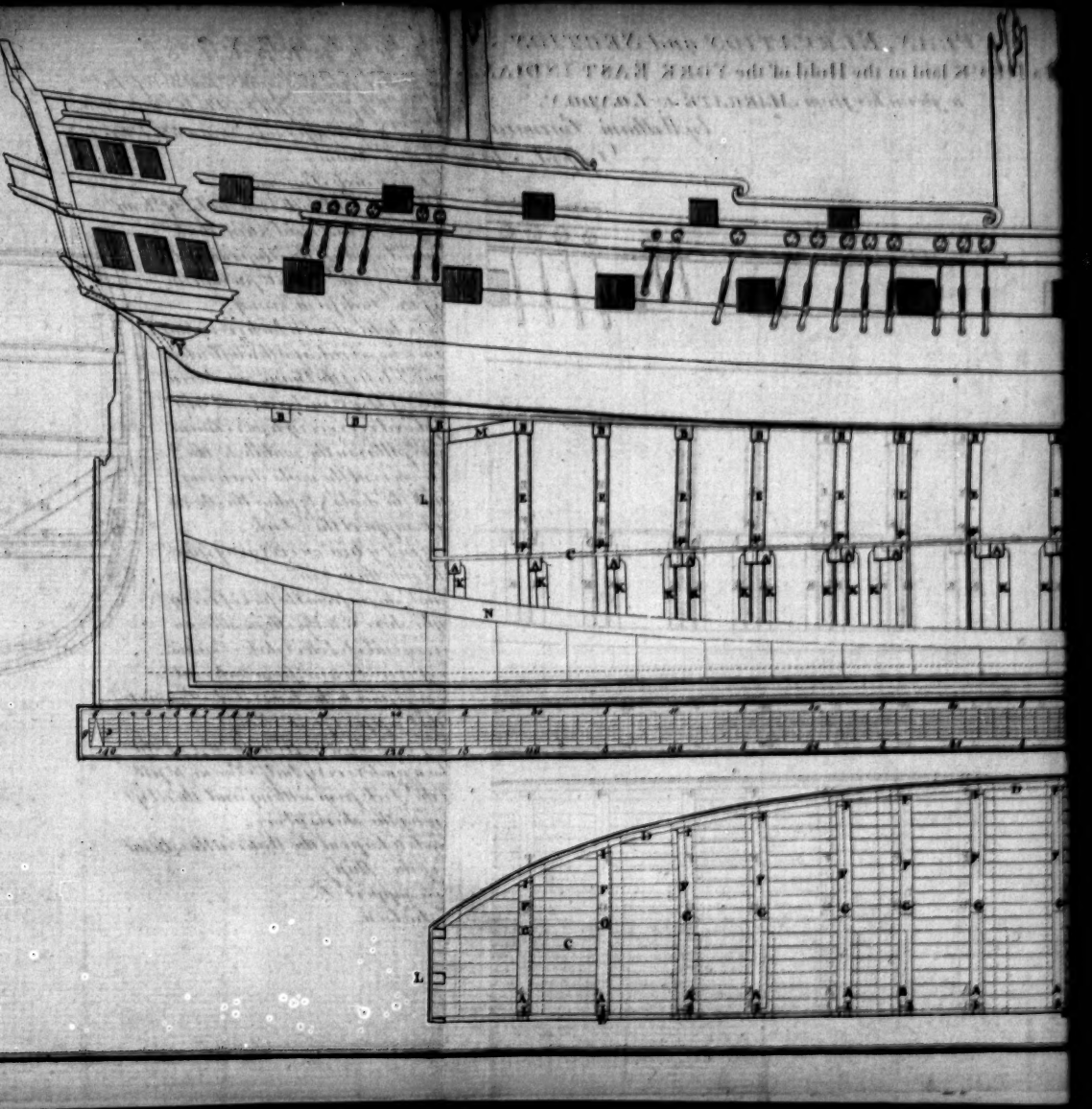
K. Shores of 10 in. by 3 in. from the top of the Keelson under every half Beam, to prevent the Deck from settling, and thereby loosening the Shores above.

L. Bulkheads to keep out the Water in the extreme ends of the Ship.

M. Shores to support D.ᵒ.

N. Ships Keelson.

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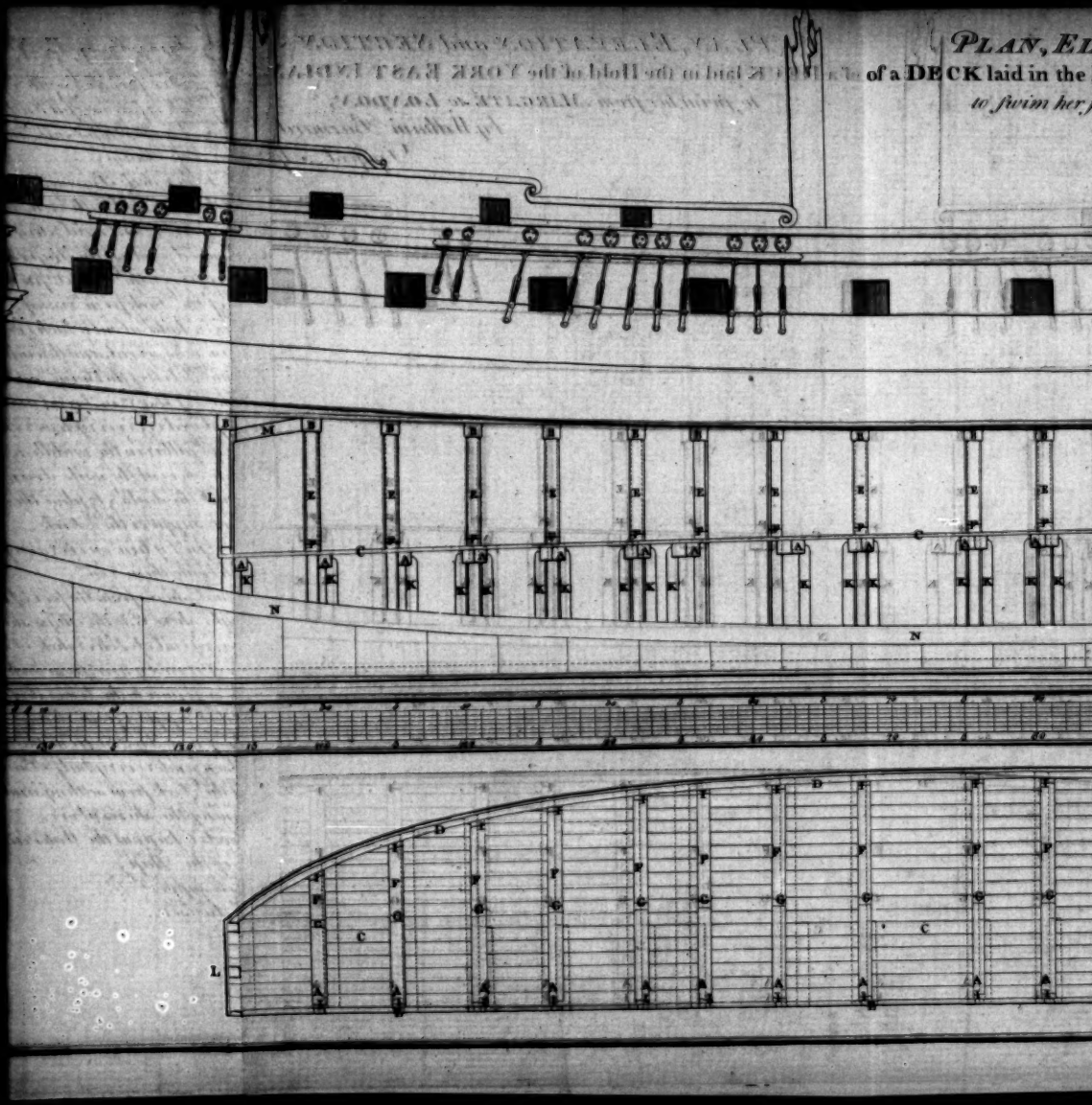
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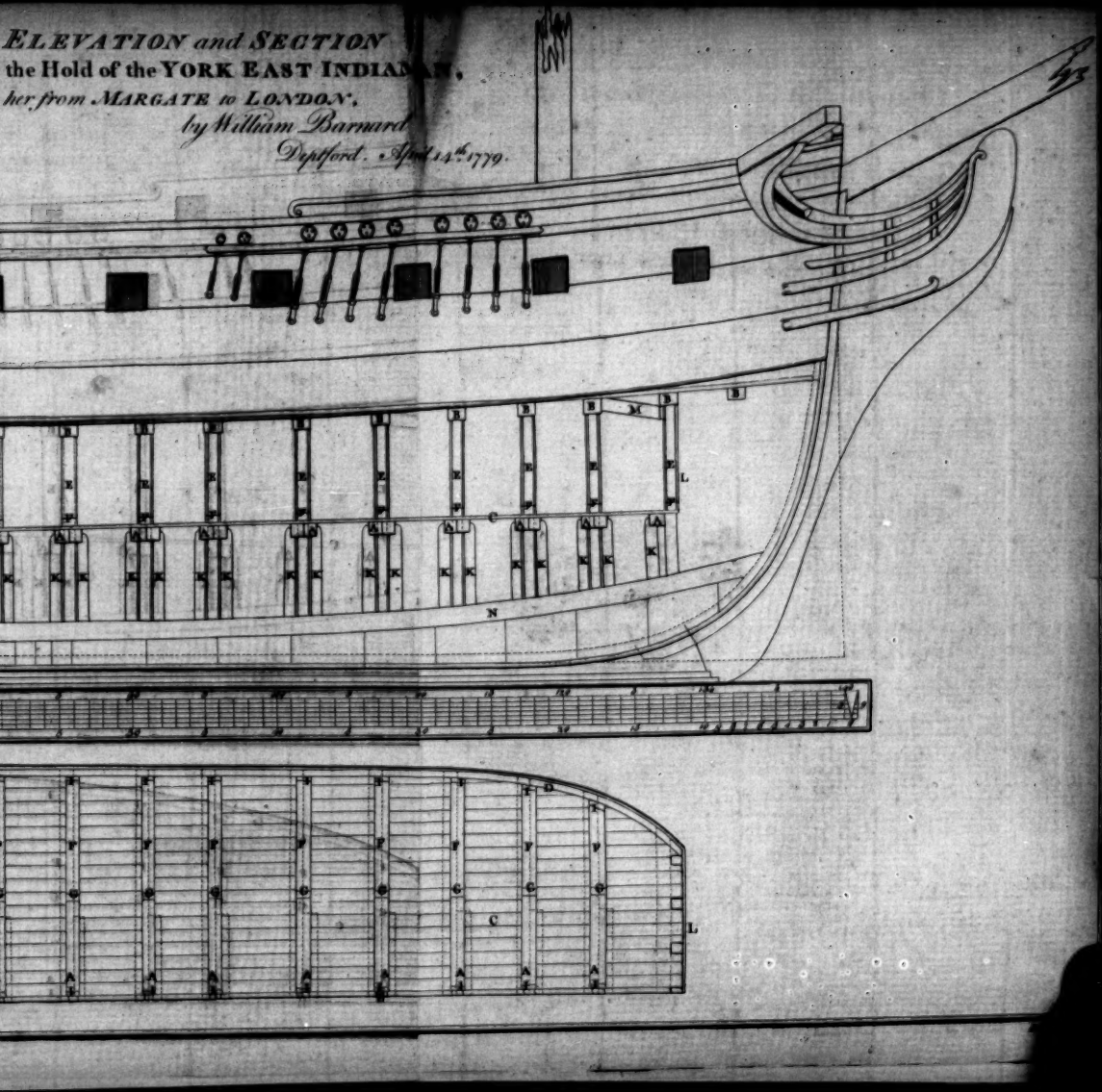
ELEVATION and SECTION
the Hold of the YORK EAST INDIAMAN,
her from MARGATE to LONDON.
by William Barnard
Deptford. April 14th 1779.



REFERENCES.

A. Beams of Fir 6 in.^{s} by 12 in.^{s} under every Lower deck Beam in the Ship.

B. Upright pieces 6 in.^{s} by 12 in.^{s} two to every Beam, well bolted on each side the Kelson and to the Beams.

C. Flat of the Deck laid with long two inch Deals.

D. Pieces of Fir fore and aft on each side over the Deck, well nailed to the Ships side to prevent the Deck from rising.

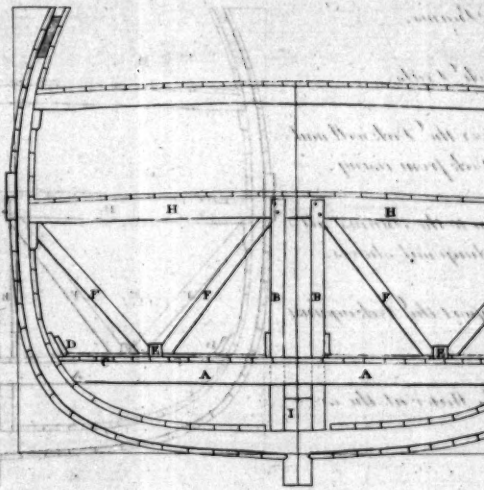
E. Pieces of Fir of 6 in.^{s} square bolted down to the Beams all fore & aft, to support the heels of diagonal shores.

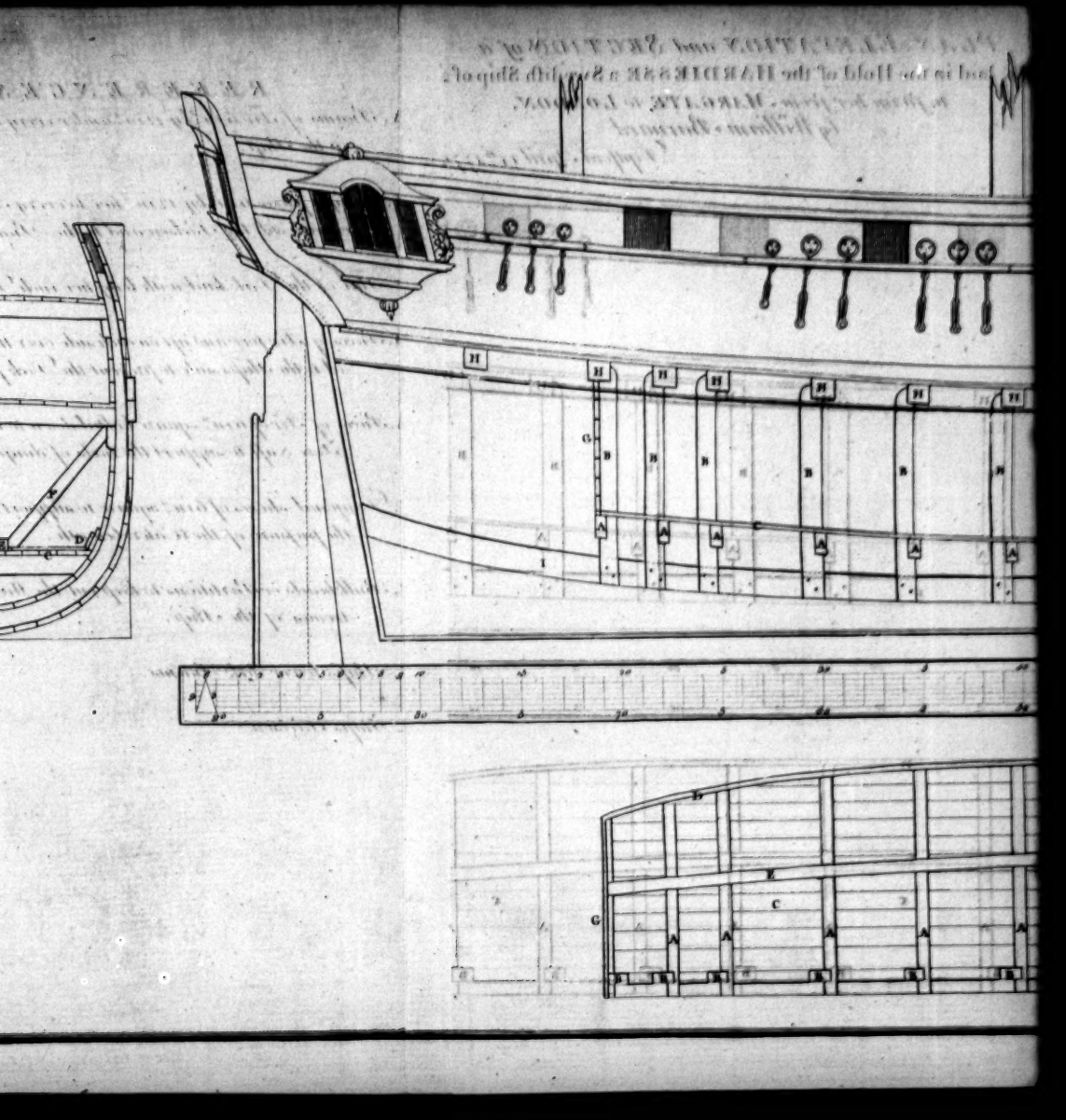
F. Diagonal shores of 6 in.^{s} square to support the Deck against the pressure of the Water beneath.

G. Bulkheads or Partitions to keep out the Water at the extremes of the Ship.

H. Ships lower deck Beams.

I. Ships Kelson.

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DECK laid in the Hold

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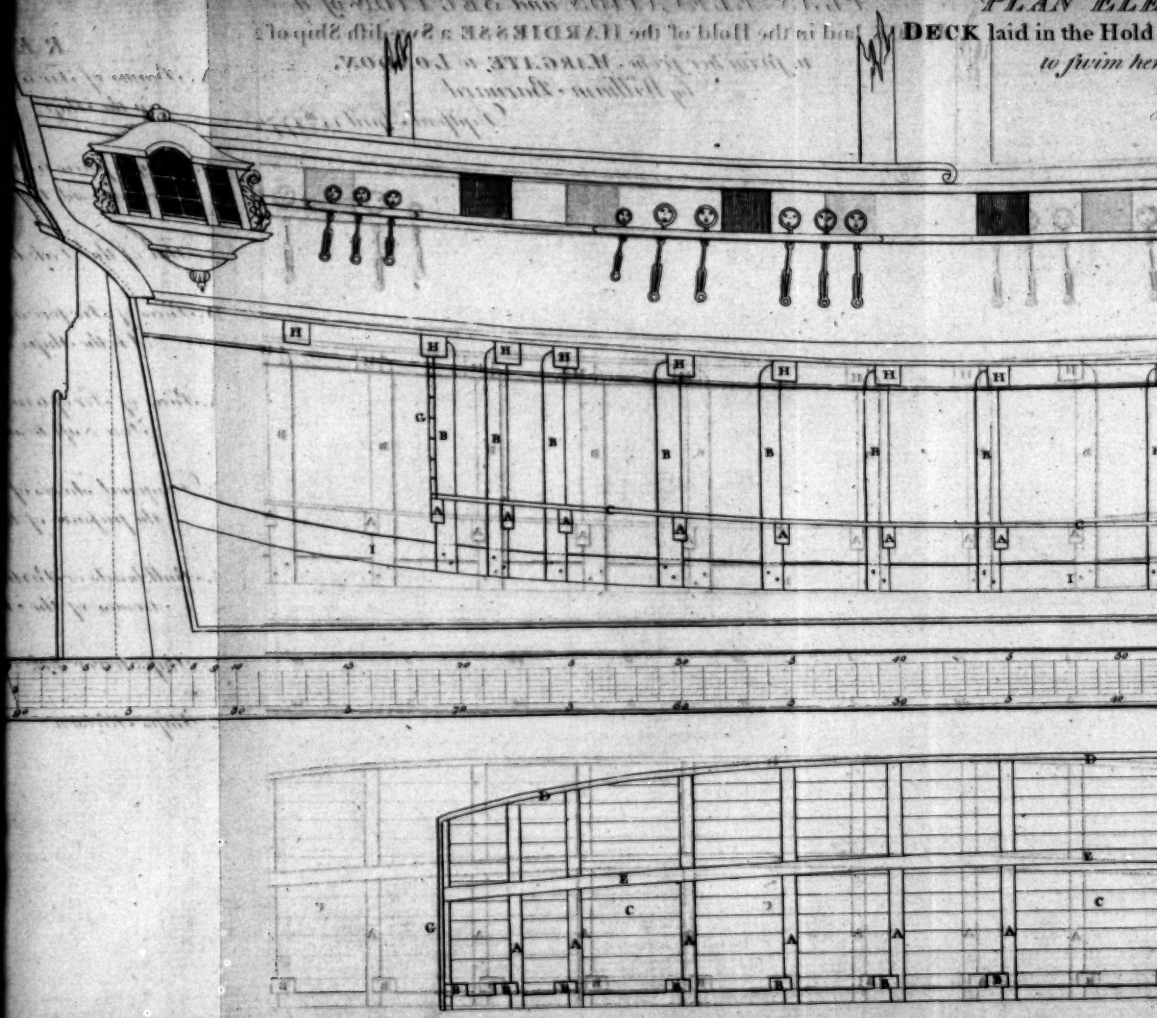
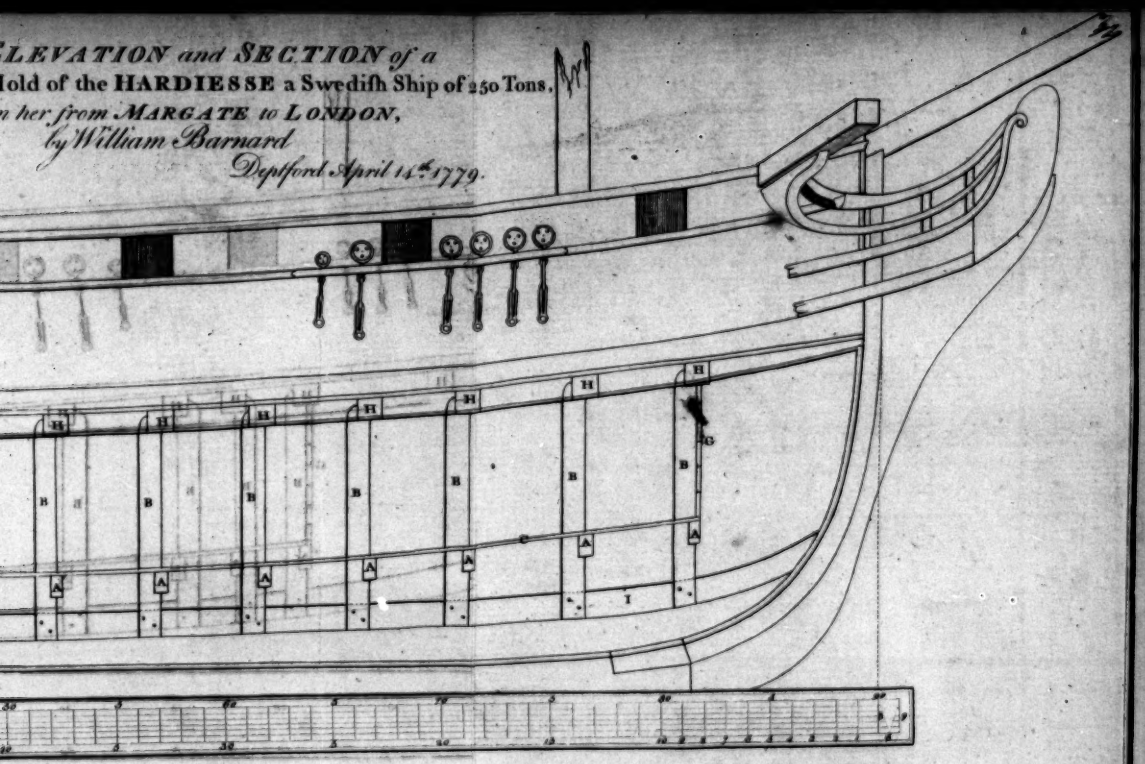
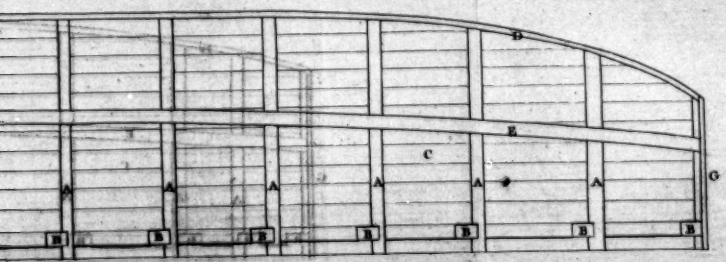


ELEVATION and SECTION of a
Hold of the **HARDIESSE** *a Swedish Ship of 250 Tons,*
as her from **MARGATE** *to* **LONDON,**
by William Barnard
Deptford April 14th 1779.





Basire Sc.

VII. *Experimenta quædam novum acidum Animale ſpectantia. Autore* F. L. F. Crellio, *M. D. et Prof. Chemiæ*, Helmſtadienſi; *communicated by* William Hunter, *M. D. F. R. S.*

Read Jan. 13, 1780.

SEPTEM nunc fere elapſa ſunt luſtra, ex quo perill. J. A. DE SEGNER, vir inter mathematicos celeberrimus, novum acidum, idque animale, atque ex pinguedine erutum[a] detexit, eoque, qualia incrementa ab illo ſperare potuiſſet chemia, ſi glorioſe inchoatam viam proſequutus eſſet, pleniſſime patefecit. Acidi naturam penitius introſpiciendi deſiderium non movit alios, poſt SEGNERUM chemicos ad plura capeſſenda pericula, quum meſſis forſan non ſatis larga relicta illis videretur; ſed et ſparſos adhuc colligere flores prementi tanti viri veſtigia profuiſſet.

Præcipua SEGNERI experimenta hæc ſunt. Sebum bovillum colatum leni igne arenæ balneo diſtillavit, præpoſitis in excipulo aquæ ℥ iij; olei, quod ſub vaporibus oculos acerbiſſime pungentibus prodibat, cum ℥ ij tranſiiſſent,

(a) Diſſ. Inaug. de acido pinguedinis animalis; præſide O. A. SEGNERO Reſpond. D. H. KNAPE. Gott. 1754.

excipulum

excipulum mutavit, nova præpoſita aqua. Iterum olei ℥ ij evocavit; tunc aliud vas, aqua repletum de novo appoſuit; continuato hoc modo opere, donec aqua non amplius ſaporem acidum referret. Quæ in excipulo inveniebantur, ex oleo, partim coacto, partim fluido, et aqua conſtabant. Hæc calori per aliquot dies expoſita, concuſſa, per infundibulum ſeparabat: aqua obtenta odoris ſaporiſque erat pungentis, et cum ſale alcalino efferveſcebat; quod quidem acidum, in aqua degens, ab hujus parte ſuperflua liberabat, diſtillando ad dimidium, vel quouſque aqua ſaporis atque odoris expers eſſet; reſidua portio quo diutius operatio continuatur, eo majori acredine prædita tranſtillat. Quo majorem puritatis gradum acquirat acidum, cum ſufficienti quantitate ſalis alcalini ſaturandum, hoc lixivium evaporandum, tunc addendum eſt oleum vitrioli ea quantitate, ut dimidium ſit ponderis aſſumti ſalis alcalini. Qui tunc tranſit ſuper alembicum liquor, purus eſt, limpidus et valde acidus, tantiſper tamen adhuc oleoſus. Quod oritur ex combinatione hujus acidi et ſalis alcalini vegetabilis ſal medium, ad terram foliatam tartari accedit, et ſpiritum vini eodem modo tingit; integre tamen in eo non ſolvitur: fixum eſt, nec ſuper carbonibus crepitans, nec ignem concipiens. Ex analogia technologiæ chemicæ nomen tartari animalis illi imponere fas mihi videtur.

Alcali

Alcali volatile, huic acido nuptum, ſal conſtituit ſapore ſalis ammoniaci, relinquens in lingua ſenſum refrigerii; igne ſublimatur in flores niveos: nomen ſalis ammoniaci animalis meretur.

Hæc ſunt præcipua, quæ de hujus acidi, e pinguedine bubula (ut cætera taceam) eruti, analyſi nobis tradidit SEGNERUS. Superſunt adhuc quædam nondum tentata experimenta, quæ naturam illius interius declarant, et quæ nunc tua pace, vir celeberrime, tibi referam. Ex antea enim dictis nondum patet proportio partium conſtituentium, olei ſcilicet, acidi, et terræ in pinguedine; quam ut eruerem ſequenti modo rem aggreſſus ſum.

EXP. 1. Sumſi lardi bubuli, fuſi, colatura a rebus peregrinis liberati, libras 11; retortam vitream ad dimidiam illius partem illo ſolo replevi, atque commiſſuris vaſorum bene clauſis expoſui igni reverberii in arenæ balneo. Cum ſebum omne fuſum eſſet, tranquille diſtillabat, non valde ſpumeſcens, nec ultra unam quartam partem ſpatii, quod antea occupabat, ſeſe extendens. Primo prodibat oleum tenue, quod fluidum remanebat; tunc acidum fundum petens, et cum illo oleum, quod igne debiliori, utut ex retorta cadebat, protinus coaluit; illo vero adaucto, ut gutta guttam truderet, hoc iterum fundebatur, in excipuli autem fundo paulo poſt iterum denſatum. Fluidum, ut omne tranſcenderet (quod 16 horis factum eſt) ignis

requirebatur vehementior, ſic ut fundus catini ferrei bene igneſceret. Vaſis frigefactis magna pars olei tranſtillati coacta erat: excipulo aperto odor ſurgebat haud fere tolerabilis, et nares, et oculos vehementiſſime vellicans, ſic ut animam fere intercluderet. Fluidum decantatum ʒ iij ß, ſcrupul. ſemis æquabat, quod ex duobus liquoribus diverſi generis conſiſtens, ope infundibuli ſeparabatur. Oleum viridiuſculum, olei abſinthii colorem tenens, ʒ j, ʒ vij, ſcrupul. ij librabat: ponderoſius acidum, aurei coloris, pungentiſſimum, ʒ j, ʒ iij ß. Reſiduum oleum coactum, lardo ſuillo ſimile, odore quidem pungente adhuc præditum erat, qui vero illi non proprius ab acido non penitus ſeparabili ortum ducebat. In retorta remanebat carbo, concuſſu a parietibus ſecedens, per fragmenta e vaſe educendus, ad tactum lævis, coloris ſplendentis, ponderis ʒ j, ʒ iv ß.

EXP. II. Oleum coactum in excipulo, ut funderetur, ignem requirebat non lenem ſed tamen non adeo fortem, quam qui ſebum ipſum liquefecerat; quod prout diffluebat, in retortam infundebatur. Ignis ad hanc diſtillationem adhibitus erat inter 430—450° therm. FAHRENH. quo gradu, cum nihil amplius tranſiret, operatio finiebatur. In excipulo iterum inveni oleum coactum, et quod ſupernatabat fluidum, ponderis erat ʒ v, ʒ vj, odoris non adeo penetrantis, quam in priori experimento maxima

parte ex oleo aurei coloris conſtans parum acidi admixtum erat: $\frac{1}{18} - \frac{1}{20}$.

EXP. III. Oleum denſatum minori, ut in exp. 2. liqueſcebat calore; quo facto addebatur reſiduæ ab illo in retorta maſſæ, ejuſdemque ignis gradui committebatur; quo eadem oriebantur phænomena, quæ modo deſcripſi. Fluidi accepi ℥ vj, ʒ j ß, quod pallidioris erat coloris, et flavedine ſulphuris æmula tinctum; parca iterum erat acidi portio.

EXP. IV. Portioni quæ iſti caloris gradui reſiſtebat, addebatur, liquefactione prægreſſa, oleum denſatum, atque igni reverberii exponebatur. Vaporum pars quædam lutum, ex farina et aqua confectum, penetrabat, qui candela adhibita flammam concipiebant cœruleſcentem, at adeo debilem, ut chartam luto illinitam, vaſorum commiſſuras occludentem lædere non valeret. Quibus vero rurſus prorumpentibus vaporibus novum ſuper impoſitum lutum exitum mox cohibebat. Diſtillatio ad ſiccitatem uſque protracta dabat multum olei coacti, et paululum fluidi, cuique pondus erat ℥ j, ʒ v ß; acidi huic admixti exigua erat portio, $\frac{1}{8}$ fere, cuique color valde pallidus, oleum vero intenſius erat tinctum, atque ex rubro flavum. Olei pars coacti cum mollis eſſet, quidpiam olei fluidi, et acidi evoluti retinuit, fluidiſſima modo parte decantata. Carbo fundum occupans, ponderabat ʒ vj, ϑ ij, eique in exp. 11. obtento perfecte ceterum ſimilis.

EXP. V. Liquefacto exper. antecedentis oleo, ignis ſubjiciebatur diſtillatorius, ejuſdem gradus, ut in exp. 2. et 3. Obtinui ʒ ij fluidi, cuique pars circiter $\frac{1}{14}$ acida erat, parum colorata, fere alba; oleum vero coloris ſaturate ſulphurei.

EXP. VI. Quod denſatum erat oleum, leni calore recuperavit fluiditatem (quæ quidem poſt quamvis peractam diſtillationem ſemper imminutum ignem poſcebat, utut ſcilicet oleum mollem magis naturam acquirebat): reſiduæ in vaſe retorto maſſæ additum, eandem caloris vehementiam ſuſtinuit, ac in exp. 5. atque dedit fluidi ʒ j ß ejuſdem coloris ac naturæ, ut antecedens.

EXP. VII. Reſiduum nunc igni reverberii expoſui, addito antea oleo coacto exp. 6. Quod obtinui fluidum, ponderis ʒ ij, ʒ v ß erat, cujus pars acidi parca flava, oleoſa vero ex rubro fuſca erat. Carbo ʒ j, ʒ vij.

EXP. VIII. IX. Seboſa materia fuſa, ex retorta diſtillabatur iterum reverberii igne; quo facto, in excipulo inveniebam ʒ j, ʒ ij, olei ſaturatioris quam antecedens, cui parciſſima acidi flavi quantitas admixta erat. Quum reſidua in vaſe maſſa, nondum in carbonem converſa eſſet, ſed oleo adhuc ſcatens; addidi ei parvam illam olei coacti quantitatem, iterumque ad ſiccitatem uſque diſtillavi, atque obtinui olei fuſci ʒ ß una cum acidi tantillo, cui innatabat parca quantitas olei coacti, quod ad pondus ℈ j

accedere

accedere mihi videbatur: modico calore applicato, oleo fluido ſeſe admiſcebat; quo vero calore orbatum iterum ex illo ſecedebat ſub forma, terræ foliatæ tartari ſimili: increſcente vero paulo poſt atmoſpheræ calore, hoc cum illo ſemper intimo connubio junctum deprehendebatur. Reſiduum ex hac diſtillatione erat carbo, pond. ℥ vj ß.

Hac itaque methodo tota lardi bubuli quantitas in ſuas partes reſoluta erat; reſtabat adhuc, ut, quæ oleo admixta erat portio acida, ab eo ſepararetur.

EXP. X. Confudi itaque quæcunque obtinui diſtillationis ope e ſebo fluida, atque ope infundibuli ſeparavi acidi, aureo ſplendore nitentis, ℥ iij, ℥v, olei vero, cui color erat ex rubro fuſcus, ℥ xxj ß. Si iſti ponderi fluidorum, ſcil. ℥ xxv, ℥j, additur iſtud carbonum in diverſis operationibus obtentorum, nempe ℥ v, ℈ ij, apparet, de tota ſebi maſſa, omni quamvis cura adhibita, deperditas eſſe ℥ j, ℥ vj, ℈ j; quod vero mirum non erit perpendenti, tot fuiſſe diſtillationes, tot olei coacti liquefactiones, quæ avolandi occaſionem haud facile impediendam fluidis dederunt; partem præterea quoque harum, vaſorum parietibus tenacius adhærentem ex illis effundi non potuiſſe.

Oleum etſi accuratiſſime quantum ope mechanica licet, ab acido ſeparatum, cum annotante SEGNERO, partem tamen hujuſce abſcondat, hoc ex illo elicere omni ſtudio allaboravi.

EXP. XI. Adjeci itaque omni oleo aquæ portionem æqualem; tunc illud calori digeſtionis expoſui atque ſæpius concuſſi; quo facto aqua ſaporem acidiorem acquirebat, et addito ſale alcalino efferveſcebat. Atque hæc omnia toties repetii, donec aqua nullo amplius ſapore gauderet, nec cum alcalinis conflictaretur.

Sed accuratius paulo inveſtiganda erat quantitas hujus in oleo latentis acidi; quem in finem ſequenti modo rem confeci.

EXP. XII. Salis tartari puri ʒ ß adieci acidi exp. 10. quantum ad illius plenariam ſaturationem requirebatur, eoque modo conſumſi hujus ʒ vj ß; quod vero ſal medium pro norma inſtituendæ computationis mihi paravi.

EXP. XIII. Aquæ itaque acido impregnatæ exp. 11. injeci ſal tartari, cujus ʒ ij ad omnis acidi abſorptionem vix ſufficiebant. Si itaque hujus quantitatem ad ductum exp. 13. computo, accedet ad ℥ iij, ʒ ij.

EXP. XIV. Olei ex rubro fuſci, aqua edulcorati (exp. 11.) ℥ iij, adiecta iterum pari portione aquæ diſtillatæ, igni lampadis expoſui, et obtinui, ante tranſitum hujus, oleum limpidum odoris et ſaporis, qualis fere eſt, olei ætherei: deinde cum aqua quoque tranſibat olei albi portio; poſtquam vero illa penitus tranſcenderat, lampadem removi, et ℥ iij olei ſeparavi ab aqua, acidulo ſapore impregnata.

EXP.

EXP. XV. Eidem oleo toti (exp. xi.) per ſe lampadem ſuppoſui, et par (exp. 14.) oleum limpidum elicui: in fundo hærebat acidi rubeſcentis parca portio.

EXP. XVI. Hoc oleum exp. 15. in vaſis circulatoriis paulo vehementiori igni expoſitum, ſaturatiorem pedetentim acquirebat colorem, donec in fuſcum badium tranſiret[b].

EXP. XVII. Reſiduum ex diſtillatione exp. 15. fortiori igni expoſui, donec omne tranſtillaſſet, quod erat coloris aliquantulum dilutioris, quam ante operationem. Ignis vehementiæ reſiſtebat pars, quæ retorta diffracta, carbo erat ponder. ℥ iij, ʒ xviij, perfecte ſimilis illi exp. 1. 4. 7. 9.[c].

EXP. XVIII. XIX. Olei (exp. 14. 15.) ʒ iij in ſpiritus vini ℥ ij inſtillavi, cujus dimidiam partem in vaſis circulatoriis leni igne digeſſi; alteram in retorta diſtillavi: prior partem olei ſupernatantem non ſolutam monſtrabat; poſterior ſoluta erat.

EXP. XX. Utrique addidi aquam, quo facto mixtum colore erat lacteſcente, quem cum amiſiſſet, claraque evaſiſſet, oleum ſuperficiem petiit.

EXP. XXI. XXII. Olei rectificati (exp. 14.) ebullientis ℥ j inſtillavi ſalis tartari cauſtici calidique ʒ j, quod fere to-

(b) Idem, analogia ductus tentavi cum oleo animali Dippelii, et vehementiori igne eandem mutationem paſſum eſt.

(c) Collatis inter ſeſe exp. 10. 13. 17. et computo ducto, apparebit, ineſſe ſebi lb. ij, olei puri ℥ xiv, acidi ℥ vij, ℈ ij, carbonis ℥ x, ʒ vj, ℈ j.

tum

tum citiſſime abſorbebatur; adjeci adhuc ʒj ß, quæ ad digiti unius altitudinem ſalem tegebat. Digeſtum horarum 2 ſpatio, in ſaponem converſum erat; ſic dicto nigro ſimilem [d]. Eadem res cum oleo exp. 11. æque felici fere negotio ceſſit.

EXP. XXIII. XXIV. Spiritum ſalis ammoniaci cum calce viva paratum adjeci oleo rectificato; eodem momento lacteſcebat, ſolutæque ſic ſaponis ſpeciem conſtituebat. Cum oleo exp. 11. idem prorſus ſimili rependebatur ſucceſſu.

EXP. XXV. XXVI. Idem tentavi cum ſale alcalino volatili cryſtallifato, quod injeci oleo rectificato: ſal in fundo hærebat haud ſolutum. Applicato igne illud collum vaſis petiit, nec combinationem iniit cum oleo. Nec feliciori ſucceſſu idem cum ſale in parciſſima aquæ quantitate ſoluto ſum periclitatus.

EXP. XXVII. XXVIII. Oleum vitrioli album oleo exp. 14. inſtillavi; pars coagulata picea a ſupernatante fluidiori mox reſolvebatur, fluidumque ſiſtebat atro fuſcum, odoris olei fere canabini rancidi. Oleum totum eadem phænomena edidit, niſi quod pars coagulata non integre ſoluta erat. Utrique aquam adjeci, qua omnia diſſolvebantur,

(d) Sic itaque facillimo negotio ſaponem ſic dictum Starkeaynam confeci, qua methodo cum aliis oleis æthereis in 2 dierum circiter ſpatio, parem licet componere ſaponem, quamvis alio modo ſit res difficillima.

ſaponis ſoluti forma. Alcali adjecto, oleum nigricans ſuperficiem petebat; fluidumque evadebat pellucidum.

EXP. XXIX. XXX. Spiritum nitri fumantem, tertia parte olei vitrioli auctum, adieci oleo albo: nullus fumus, nec flamma, nec combinatio, aut condenſatio. Spiritus nitri inferiora occupabat, colorem perdidit intenſiorem, et ſtramineum acquiſivit; ſuperiora occupans oleum e contrario coloris erat aurantii ſaturati.

EXP. XXXI. XXXII. XXXIII. Oleum exp. 10. cum eodem nitri acido mixtum, fumum edebat, coagulabatur, et particulæ quædam deſcendebant, quæ carbonaceæ videbantur. At fluido decantato aqua adjecta ſolvebantur, et liquidum conſtituebant coloris ſtraminei, ſaporis amarulenti. Evaporata aqua, concrementum accepi flavum, facie quadam ſalina lamellata, quod ſolutum, ſpiritum vini colore induebat aureo. Sale tartari, ſolutioni aquoſæ adjecto, nulla olei evenit ſeparatio.

EXP. XXXIV. XXXV. Spiritus ſalis fumans, mixtus cum utroque oleo, amice ſe illi junxit, nec mutationem fere ullam produxit; parca modo illius quantitate coacta, quæ a fluidis liberata, aëri expoſita, purpureum acquiſivit colorem. Oleum ſuperficiem tegens, ſpiritui qualitatem fumantem diu conſervavit, quamvis in vitro vini potui deſtinato, aëri acceſſui expoſita erant.

EXP.

EXP. XXXVI. XXXVII. Spiritus veneris concentratiſſimus (viridi vero imbutus colore) mixtus oleo rectificato, nullo modo in illud agebat; ſed calori expoſita, ut ebullirent, priſtinum colorem exuebant; albumque antea oleum nunc gaudebat fuſco dilutiori; viride vero acidum fuſco utique, at ſaturatiori; ſedimentum nullum apparebat. Fluidum odorem penetrantiſſimum, illi ſimilem, quem in exp. 10. deſcripſi, et tunc adhuc edebat, ſi acidum ab oleo, mediante infundibulo ſeparatum erat. Odor itaque ab oleo, concentrato acido intime nupto, provenire videtur.

EXP. XXXVIII. Carbonis, qui olei diſtillatione peracta remanſit, natura adhuc inquirenda eſt, quod ut fieret, incinerationem tentavi. At enim vero hæc difficillime ceſſit; per plures enim horas in crucibulo capaci aperto, qui totus candebat, carbonem detinui, et vix ullam mutationem paſſus eſt. Confici itaque curavi ex materia lateritia vas planum, parvo limitatum margine, pediculo intra prunas, furnum anemium occupantes, elevatum, ut flamma ſuperficiem illius, carbone comburendo tectam, lambere poſſet. Hoc modo, diu tamen continuata calcinatione, in cineres converſus eſt, atque de ℥ ij remanſerunt ʒ iij.

EXP. XXXIX. Cineri, qui rubrum quemdam colorem induit, adjeci aquæ diſtillatæ ℥ ij: leni igne digeſſi, et

colavi. Sapore inſtructa erat ſalino; qua vero evaporata ad cuticulam, nullæ apparebant cryſtalli; continuata vero ad ſiccitatem evaporatione obtinui grana 41 ſalis, incertæ prorſus figuræ, et ſingularis ſaporis; in aëre non deliqueſcebat.

EXP. XL. Quum experimentis clariſſimi GAHN, quibus phoſphorum novo parare modo docet, conſtet, ineſſe animalibus ſal medium terreum, ex acido phoſphori et terra calcaria compoſitum, an ſal noſtrum fixiſſimum ejuſdem naturæ ſit, inquirere animo occurrit. Soluto itaque in aqua diſtillata, addidi guttas aliquot acidi vitriolici, quo protinus moleculæ albæ deſcendebant, manifeſto indicio, huic ſali terram infuiſſe calcariam, quæ illi acido jungi maxime omnium amat.

EXP. XLI. Præcipitatum, a fluido, per filtrum ſeparatum, liberavi aqua, et obtinui ſalem albidum acidi ſaporis, quod fiſtula ferruminatoria in vitrum pellucidum abiit. In aqua ſolutum, ad conſiſtentiam mellis evaporatum cum fuligine tedæ miſcui, retortæ terræ loricatæ injeci, atque eidem ignis gradui, quo phoſphorum parare ſolent, commiſi. Tribus vix horis præterlapſis lætus vidi collum retortæ, quod aquæ proximum erat lumine phoſphorico conſpicuum, quod per horam et ultra ſubſtitit; at phoſphorum ſub aqua (ob parcam maſſæ quantitatem) non obtinui.

EXP. XLII. Cineribus ſale orbatis (exp. 39.) ſiccatis, adjeci aquæ fortis ℥j ut ea terram calcariam, et præcipue ferrum, quod adeſſe ex colore ſuſpicatus ſum, extraherem. Per 24 horas leni igne digeſſi: cineres non eo quidem amplius gaudebant colore, at nitri acidum non illo indutum erat, quo ſolutio ferri eſſe ſolet; ejuſque guttæ, infuſioni gallarum inſtillatæ, nec colorem ad atrum vergentem producebant. Ruber iſte itaque color non a marte, ſed a principio inflammabili, ut ſæpe fieri ſolet, ortum duxit.

EXP. XLIII. Liquori illis fœtò, quæ ex cineribus extraxerat aqua fortis inſtillavi vitriolicum acidum, quo facto turbidus evaſit, et ad fundum particulas depoſuit ſeleniticas; quibus elucet, terram adhuc adfuiſſe calcariam nulli acido unitam. Hiſce filtro ſeparatis, reliquum evaporavi; aſt omne in auras abiit.

EXP. XLIV. Quæ nitri acidum ſolvere haud potuit, ea edulcoravi, exſiccavi; ponderis erant ℥ ij. Hiſce affudi ℥j olei vitrioli, forti igne omne fluidum evocavi; tunc cum aqua diſtillata coxi. Fluidum, peracta filtratione, evaporavi; quo facto obtinui cryſtallos parvas, ſaporis aluminoſi, quæ terram e ſale ammoniaco præcipitabant, eamque ipſæ, adjecto ſale alcalino, dimittebant.

EXP. XLV. Edulcoratum, exſiccatumque reſiduum æquali portione ſalis alcalini mineralis junctum fudi in crucibulo

crucibulo forti igne; atque obtinui optimæ notæ vitrum pellucidum. Supereſt adhuc ut acidum, ejus naturam, actionemque in alia corpora examini ſubjiciam.

EXP. XLVI. Acidum exp. x. leni calori expoſui, et diſtillavi; quod tranſibat, coloris erat albidi ad flavedinem vergentis; in fundo remanebat maſſa carbonacea, quodammodo unguinoſa. Tentamen, quod inſtitui, ut phlegmate, leni igne evocato, fortius obtinerem acidum, felici deſtitutum erat ſucceſſu; liquidum enim in excipulo ejuſdem erat acoris, ac illud in retorta.

EXP. XLVII. De ſale, ex alcali vegetabili et acido noſtro orto, jam ſupra, et exp. 12. retuli: ſupereſt adhuc aliud fixi generis. Affudi nempe ſalis alcalini mineralis cryſtalliſati ʒiij acidum exp. 46. ad plenariam ſaturationem; eoque modo conſumſi ʒ v. Evaporavi ad cuticulam uſque; ſed cum cryſtalli fuſco gauderent colore omnem humiditatem expuli; fudi leni igne quo uſque fumum non amplius ederet, aut particula, e crucibulo hauſta, ſolutionem in aqua redderet limpidam, et carbonaceam materiam ad fundum deponeret. Tunc maſſam ſalinam ſolutam ad cryſtalliſationem diſpoſui, atque obtinui maſſam ſalinam, ex cryſtallis quadratis, in pyramidem triangularem ut plurimum deſinentibus, compoſitam, quæ aëri expoſita pulvere albo farinoſo tegebatur.

EXP. XLVIII. Saturando ſali alcalino volatili ℥x acidi impendi. Leni igne in cucurbitula capitello inſtructa expoſitum, aquoſos, odoris et ſaporis expertes vapores edidit, nec in altum tolli ſe ſivit, niſi eodem fere ignis gradu adhibito, quo ſal ammoniacum commune elevari ſolet. Flores tunc capitello et cucurbitæ collo ſe apponebant albiſſimi.

EXP. XLIX. Terra calcaria ſolvebatur non ſine inſigni efferveſcentia, ut ejus ℥xj ab acidi noſtri ℥ij ſuſciperentur. Idem ſal paravi, miſcendo ſebum cum calce viva pulveriſata, illud leni igne fundendo; tunc cum aqua coxi; et colatura evaporata concrevit in maſſam ſalinam. Melius adhuc res ceſſit, cum ſebum calce mixtum, diſtillarem. Lixivium ad debitam conſiſtentiam evaporatum cryſtallos ſtitit fuſcas, quas itaque fudi (ut in exp. 46.) tunc aqua diſtillata ſolvi, ſuperfluam expuli, et obtinui cryſtallos pellucidas hexagonas, plana terminatas ſuperficie. Sapor acris ſalſus eſt, ſed non adeo urens, ut ſal ammoniacum fixum: in aqua facile ſolubilis, aëre vero non deliqueſcens; ſpiritui vini non obtemperat. Salis calcarii animalis nomen non ineptum videtur.

EXP. L. Efferveſcendo magneſia alba quoque ſolvitur, et ℥ix, acidi ℥ij ſaturaverant. Mixtum omni quamvis data opera nullam formam cryſtallinam induit; potius

maximam partem in maſſam gummoſam concrevit, quæ aëri expoſita deliqueſcebat ſaponiſque erat amarulenti.

EXP. LI. Terra aluminis non abſque difficultate acido noſtro ſe junxit: hujus enim ʒij addebam præcipitati, ex alumine et ſale alcalino fixo nati, edulcorata adhuc madidi (*c*) ʒ ß; ſolutum quidem in initio omne crederes; at paulo poſt magna pars (dimidia ſcilicet ut videbatur) fundum petiit. Colatum fluidum in cryſtallos coire denegabat; ſapor erat adſtringens, non dulceſcens, potius auſterus. Terram ſolutam demonſtrabat adjectum alcali, quo addito præcipitabatur continuo. Nomen aluminis animalis imponendum ei videtur. Affinitatem non arctam intercedere terræ aluminoſæ cum noſtro acido, probat commixtio ſalis calcarii animalis cum ſolutione aluminis ſaturata; quo facto, ne ipſa coctione adhibita, ſelenites nulla exoriebatur; quæ vero copioſiſſima eſt, ſale ammoniaco fixo alumini addito.

EXP. LII. Terræ, e liquore filicum addito vitrioli acido ortæ, ſcrup. dimidio adjeci ʒij acidi; ſed nulla ejus videbatur in illam actio, nec digeſtione et coctione conſpicua. E liquore colato ſal alcalinum fixum nihil exturbabat; ut itaque vim in terram vitreſcibilem nullam illi ineſſe, veri ſimillimum ſit.

(*c*) Siccatam terram nempe aggredi non videtur; et ʒ ß, omni humiditate expulſa ponderis erat granor. iv.

EXP.

EXP. LIII. Quæ vero omnia corporum acido nubendorum tentamina et eum præcipue in finem inſtituta erant, ut acidum noſtrum concentretur, et eo in ſtatu ex illis expellatur. Placet inſtar omnium nunc ſalis ex acido et alcali vegetabili conflati examen proponere. Ejus ʒ xij adjeci olei vitrioli ʒ ß, et leni igne acidum noſtrum expuli, quod vaporum griſeorum forma tranſiit, eamque ſemper conſervavit. Aquæ inſtar limpidum erat, valde acidum, ponderis ʒ ß. Si ſal medium ſatis calcinatum haud eſt (exp. 46.) acidum prodiens quidem valde concentratum, aſt majori adhuc olei flavi copia combinatum deprehenditur. Hoc, ope infundibuli ab illo quidem ſeparavi, et acidum in oleo latens adjecto ſpiritu vini extrahere tentavi; ſed eodem momento, quo vini ſpiritus addebatur, oleum jam ſolutum erat, nec adjecta aqua ab illo ſeparari poterat.

EXP. LIV. Acidi concentrati (exp. 53.) ʒ ß æqualem partem ſpiritus vini optimi admiſcui. Maſſam digeſtam per 12 horas igne lampadis diſtillavi. Odor liquoris in excipulo oleo vini valde ſimilis erat. Adjecta aqua lactis fere faciem induebat; paulo poſt ſuperficiei innatabat oleum, reddita antiqua pelluciditate, ponder. ʒ iij, ſaporis aromatici, ſed oleo vini mitioris. Hoc itaque periculo novum accedit robur ei ſententiæ, acidum nempe quodvis, ope vini ſpiritus producere poſſe oleum tenuiſſimum

artificiale; noſtra vero in ſpecie naphtha virtutibus medicis quam maxime pollere cenſenda eſt, quæ penetrantiſſima eſt, et originis animalis.

EXP. LV. Oleum in vini ſpiritu ſolutum diſtillavi leniſſimo calore, quo tranſiit naphtha, addita aqua conſpicua. Hac operatione oleum e flavo fuſcum ſeſe ſeparavit, et ſuperam liquoris partem in retorta occupavit. Protracta diſtillatione tandem guttulas olei in naptha, in excipulo contenta, conſpexi; quo facto finem impoſui; et ob intimiorem acidi cum vini ſpiritu quam cum oleo combinationem, majorem horum volatilitatem, a fixiori oleo ſeparavi.

Superſunt adhuc pericula hujus acidi cum metallis inſtituenda: datur quoque facilior breviorque methodus, acidum illud concentratum obtinendi, ſi nempe ſapo (ſed ſine ſale communi factus) ſolutus, adjecto alumine deſtruitur, colatumque liquidum evaporatur, tuncque cum alumine calcinato forti igni exponitur. Quod hoc modo eduxi acidum illud quam maxime ſingulare edidit phænomenon, ut, ſolum, foliola quædam auri diſſolveret. De quorum vero omnium uberiori et accuratiore tractatione, ſi hæcce indigna haud videbuntur, proxima occaſione lubentiſſime ſum communicaturus. Dabam Helmſtadii d. 11 Nov. 1777.

VIII. *Account of a Woman who had the Small Pox during Pregnancy, and who ſeemed to have communicated the ſame Diſeaſe to the Fœtus.* *By* John Hunter, *Eſq. F. R. S.*

Read January 17, 1780.

MR. GRANT'S ACCOUNT.

ON the 5th of December, 1776, Mrs. FORD had been ſeized with ſhivering and the other common ſymptoms of fever, to which were added great difficulty of breathing and a very hard cough. Mr. GRANT ſaw her on the 7th; and he took from her eight ounces of blood, and gave her a compoſition of the ſaline mixture with ſpermaceti and magneſia every ſix hours.

This had operated by the 8th two or three times very gently, when moſt of the complaints were relieved; but the cough ſtill ſhaking her violently, bleeding ſeemed neceſſary to be repeated, more particularly as ſhe looked upon herſelf to be in the ſixth month of her pregnancy. The medicine was continued without the magneſia.

In

In the evening (*viz.* the 8th) the ſmall pox appeared, which proved of a mild kind, and moderate in quantity. Its progreſs was rather ſlower than might have been expected; but the woman paſſed through the diſeaſe in great ſpirits, ſitting up the greateſt part of the day during the whole time, and taking only a paregoric at night, and, as occaſion required, a little magneſia: thus the ſymptoms were mitigated, and the cough at laſt became very little troubleſome.

On the 25th ſhe complained of a pain in her ſide. Eight ounces of blood were taken away. The next day ſhe was quite free from pain, and thought herſelf as well on the 27th as her particular ſituation would admit of; after which ſhe was not viſited by Mr. GRANT till the 31ſt, when ſhe was in labour.

Mr. WASTALL's *letter on the ſame ſubject.*

December 30, 1776, I was ſent for to Mrs. FORD, a healthy woman, about twenty-two years of age, who was pregnant with her firſt child. She had come out of the country about three months before. Soon after her arrival in town ſhe was ſeized with the ſmall pox, and had been under the care of Meſſieurs HAWKINS and GRANT, who have favoured me with the particulars here annexed.

I called upon her in the afternoon; ſhe complained of violent griping pains in her bowels, darting down to the *pubes*. On examining I found the *os tinſæ* a little dilated, with other ſymptoms of approaching labour. I ſent her an anodyne ſpermaceti emulſion, and deſired to be called if her pains increaſed. I was ſent for. The labour advanced very ſlowly; her pains were long and ſevere; ſhe was delivered of a dead child, with ſome difficulty.

Obſerving an eruption all over the body of the child, and ſeveral of the *puſtules* filled with matter, I examined them more particularly; and recollecting, that Dr. LEAKE, in his Introductory Lecture to the Practice of Midwifry, had obſerved, that it might be neceſſary to inquire, whether thoſe adults who are ſaid totally to eſcape the ſmall pox have not been previouſly affected with it in the womb, I ſent a note to Dr. LEAKE, and likewiſe to Dr. HUNTER, in hopes of aſcertaining a fact hitherto much doubted. Dr. LEAKE came the ſame evening, and ſaw the child. Dr. HUNTER came afterwards, with Mr. CRUICKSHANKS, and examined it; alſo Mr. JOHN HUNTER and Mr. FALCONER; who all concurred with me, that the eruption on the child was the ſmall pox. Dr. HUNTER thought the eruption ſo like the ſmall pox that he could hardly doubt; but ſaid, that in all other caſes of the ſame kind,

that he had met with, the child *in utero* had eſcaped the contagion.

From Mr. GRANT'S *notes.*

The eruption appeared on Mrs. FORD in the evening of the 8th of December, and ſhe was delivered the 31ſt, that is, twenty-three days after the appearance of the eruptions.

Reflections by Mr. JOHN HUNTER.

The ſingularity of the above caſe, with all its circumſtances, has inclined me to conſider it with ſome attention.

There can be no doubt but that the mother had the ſmall pox, and that the eruption began to appear on the 8th of December: alſo, that it went through its regular ſtages, and that on the 31ſt, *viz.* twenty-three days after the firſt appearance of the eruption, the woman was delivered of the child, who is the ſubject of this paper.

Secondly, The diſtance of time when ſhe had the ſmall pox before delivery, joined with the ſtage of the diſeaſe in the child when born, which probably was about the ſixth or ſeventh day of the eruption, *viz.* about fifteen or ſixteen days after the beginning of the eruption on the mother, perfectly agrees with the poſſibility of the infection's being caught from the mother.

Thirdly, The external appearance of the *puſtules* in the child was perfectly that of the ſmall pox, as muſt have appeared from the relation given in Mr. WASTALL'S

letter. Moſt of the *puſtules* were diſtinct, but ſome were blended or united at their baſe. The face had the greateſt number; and theſe were in general the moſt indiſtinct. They were ſomewhat flattened with a dent in the middle (*a*).

So far were the leading circumſtances and external appearances in favour of their being the variolous eruption; but although theſe leading circumſtances and external appearances were incontrovertible, yet they were not an abſolute proof of this being the genuine ſmall pox; therefore I muſt be allowed to conſider this ſubject a little further, and ſee how far all the circumſtances correſpond or are ſimilar to the true ſmall pox. In the ſmall pox we have a previous fever, in place of which, in the preſent caſe, we have no information but that of the mother's having had the ſmall pox within ſuch a limited time as may favour the poſſibility of infection in the womb; yet we may preſume, that the child muſt have had conſiderable fever preceding ſuch an eruption, of whatſoever kind it was.

In the ſmall pox the eruption goes through pretty regular ſtages in its progreſs and declenſion, which circumſtances we know nothing of in the preſent caſe; but

(*a*) I endeavoured to take ſome matter upon the point of two lancets; but not having an opportunity of making an experiment myſelf, I gave them to two gentlemen, who, I imagine, were afraid of inoculating with them.

even

even this fever, the eruptions, and their progreſs, are not abſolutely proofs that the diſorder is the ſmall pox when it is caught in the common and natural way: and in proof of this aſſertion it may be obſerved, that practitioners every now and then are miſtaken.

It may be aſked, what is the true characteriſtic of the ſmall pox? That by which it differs from all other eruptions that we are acquainted with? The moſt certain character of the ſmall pox, that I know, is the formation of a ſlough, or a part becoming dead by the variolous inflammation; a circumſtance which hitherto, I believe, has not been taken notice of.

This was very evident in the arms of thoſe who were inoculated in the old way, where the wounds were conſiderable, and were dreſſed every day; which mode of treatment kept them from ſcabbing, by which means this proceſs was eaſily obſerved; but in the preſent method of inoculation it is hardly obſervable: the ſore being allowed to ſcab, the ſlough and ſcab unite and drop off together. The ſame indiſtinctneſs attends the eruptions on the ſkin; and in thoſe patients who die of, or die while in, the diſeaſe, where we have an opportunity of examining them while the part is diſtinct, this ſlough is very evident.

This

This ſlough is the cauſe of the pitt after all is cicatrized; for it is a real loſs of ſubſtance of the ſurface of the *cutis:* and in proportion to this ſlough is the remaining depreſſion.

The chicken pox comes the neareſt in external appearance to the ſmall pox; but it does not commonly produce a ſlough.

As there is generally no loſs of ſubſtance in this caſe, there can be no pitt. But it ſometimes happens, although but rarely, that there is a pitt in conſequence of a chicken pock; then ulceration has taken place on the ſurface of the *cutis*, a common thing in ſores.

In the preſent caſe, beſides the leading circumſtances mentioned in the caſe of the mother, correſponding with the appearances on the child, and the external appearances themſelves, we have in the fulleſt ſenſe the third and real or principal character of the ſmall pox, *viz.* the ſlough in every *puſtule*; from all which, I think, we may conclude, that the child had caught the ſmall pox in the womb; or at leaſt a diſeaſe, the effects of which were ſimilar to no other known diſeaſe.

In opening the bodies of thoſe who had either died of, or died while under, the ſmall pox, I always examined carefully to ſee whether any internal cavity, ſuch as the *œſophagus*, *trachea*, ſtomach, inteſtines, *pleura*, *peritoneum*,

neum, &c. had eruptions upon them or not, and never finding any in any of thoſe cavities, I began to ſuſpect, that either the ſkin itſelf was the only part of the body ſuſceptible of ſuch a *ſtimulus*; or that the ſkin was ſubject to ſome influence to which the other parts of the body were not ſubject, and which made it alone ſuſceptible of the *variolous ſtimulus*. If from the firſt cauſe, I then concluded it muſt be an original principle in the animal œconomy. If from the ſecond, I then ſuſpected, that external expoſure was the cauſe; and I was the more led into this idea, from finding that theſe eruptions often attack the mouth and throat, two expoſed parts; add to which, that we generally find the eruptions moſt on the expoſed parts of the body, as the face, &c.

With theſe ideas in my mind, I thought I ſaw the moſt favourable opportunity of clearing up this point. I therefore very attentively examined moſt of the internal cavities of this child; ſuch as the *peritoneum*, *pleura*, *trachea*, inſide of the *œſophagus*, ſtomach, inteſtines, &c. but obſerved nothing uncommon. I have already obſerved, that in this child the face and extremities were the fulleſt, ſimilar to what happens in common; from all which I may be allowed to draw this concluſion, that the ſkin is the principal part which is ſuſceptible of the variolous

variolous *ſtimulus*, and is not affected by any external influence whatever.

The communication of the ſmall pox to the child in the womb may be ſuppoſed to happen in two ways; one by infection from the mother, as is ſuppoſed in the above caſe; the other by the mother's having abſorbed the ſmall pox matter from ſome other perſon, and the matter being carried to the child from the connection between the two, which we may ſuppoſe done with or without firſt affecting the mother.

Teſtimonies and opinions are various with reſpect to theſe two facts. BOERHAAVE ſeems to have been led by his experience to think that ſuch infection was not communicable: for we find that he attended a lady, who having, in the ſixth month of her pregnancy, had the confluent ſmall pox, brought forth at the regular period a child, who ſhewed not the leaſt veſtige of his mother's diſeaſe.

His commentator, however, VAN SWIETEN, ſupports a different opinion (ſee his Comment, vol. V.). He quotes a caſe from the Philoſophical Tranſactions, vol. XXVIII. N° 337. p. 165. of a woman, who, having juſt gone through a mild ſort of ſmall pox, was, by means of a ſtrong doſe of purging phyſic, thrown into a miſcarriage,

and brought forth a dead female child, whoſe whole body was covered with *variolous puſtules* full of ripe matter; but this hiſtory is founded only on the relation of a a midwife to a clergyman, and therefore not abſolutely to be depended upon as accurately ſtated: however, it is more than probable, that there was a caſe as deſcribed; and that there were really eruptions on the ſkin of the child ſimilar to the ſmall pox.

VAN SWIETEN likewiſe mentions what MAURICEAU relates of himſelf. This author teſtifies, that he had often heard his father and mother ſay, that the latter, when big with him, and very near her time of delivery, had a painful attendance on one of her children, who died of the ſmall pox on the ſeventh day of the eruption; and that on the day following the death of this child, MAURICEAU came into the world, bringing with him five or ſix true *puſtules* of the ſmall pox.

It does not appear, however, from this recital, whether or not MAURICEAU paſſed through life free from any poſterior infection; but admitting that this eruption of MAURICEAU's was truly the ſmall pox, yet I ſhould very much doubt his having caught it from the child who died of it: as it ſhould ſeem that the *puſtules* of MAURICEAU were of the ſame date with thoſe of the child who

died. VAN SWIETEN appeals to a more recent caſe, which had been reported to him by perſons of great credit, and is recorded in the Phil. Tranſ. vol. XLVI. p. 235.

" A woman, big with child, having herſelf long ago " had the ſmall pox, very aſſiduouſly nurſed a maid ſer- " vant during the whole proceſs of this diſeaſe. At the " proper time ſhe brought forth a healthy female child, " in whoſe ſkin Dr. WATSON aſſerted, that he diſcovered " evident marks of the ſmall pox, which ſhe muſt have " gone through in the womb; and the ſame phyſician " pronounced, that this child would be free from future " infection. After four years her brother was inoculated; " and Dr. WATSON obtained permiſſion of the parents to " try the ſame experiment on the girl. The operation " was performed on both children in the ſame manner; " and the *pus* uſed in both caſes was taken from the " ſame patient. The event, however, was different; for " the boy had the regular eruption, and got well; but " the girl's arm did not inflame nor ſuppurate. On the " tenth day from the inſertion of the matter, ſhe turned " pale ſuddenly, was languid for two days, and after- " wards was very well. In the neighbourhood of the " inciſion there appeared a *puſtule* like thoſe *puſtules* that " we ſometimes obſerve in perſons who, having had the " diſeaſe, attend patients ill of the ſmall pox.

In

In the epiſtles of T. BARTHOLINUS, cent. II. p. 682. there is the following hiſtory. "A poor woman, aged "thirty-eight years, pregnant, and now near the time of "delivery, was ſeized with the ſymptoms of the ſmall "pox, and had a very numerous eruption. In this ſtate "ſhe was delivered of a child, as full of *variolous puſtules* "as herſelf. The child died ſoon after birth; the mo-"ther three days afterwards." VAN SWIETEN infers, that the mother and the child were in this caſe infected at the ſame time; therefore, the child not infected by the mother.

Dr. MEAD aſſerts, that when a woman in the ſmall pox ſuffers an abortion, the *fœtus* is generally full of the contagion; but that this does not happen always. This variety, he ſays, depends on the ſtate of the mother's *puſtules* when the child is born; that is, whether they are or are not in a ſtate of purulence. Whence he has obſerved it ſometimes to happen, that on the ſecond day from the birth, or the third, or any day before the eighth, the diſeaſe caught from the mother ſhews itſelf in eruptions on the child.

Dr. MEAD here relates the hiſtory of a lady of quality, of which this is the ſubſtance. A lady, in the ſeventh month of her pregnancy, had the confluent ſmall pox, and on the eleventh day of the diſeaſe brought forth a ſon, having no ſigns of the diſeaſe on his body; and ſhe

died on the fourteenth day. The infant having lived four days, was ſeized with convulſions, and, the ſmall pox appearing, died. The doctor infers from hence, that the ſuppuration being in ſome meaſure compleated on the eleventh day, the mother's diſeaſe was communicated then to the *fœtus*, and made its appearance on the child after eight days.

If there be no abortion, Dr. MEAD pronounces, that the child will ever be free from the diſeaſe, unleſs the birth ſhould happen before the maturation of the *puſtules*. He brings a caſe to prove, that the *fœtus* in the womb may be infected by the contagion of which the mother does not partake. "A woman, who had long "before ſuffered the ſmall pox, nurſed her huſband, "under that diſeaſe, towards the end of her pregnancy; "and was brought to bed at the due time. The child "was dead, and covered all over with *variolous puſtules*.

With reſpect to the caſe quoted from MAURICEAU, it has been proved by Sir GEORGE BAKER (Med. Tranſact. vol. II. p. 275.) that Dr. MEAD drew a concluſion from it directly contrary to the author's meaning. The negative opinion appears evidently to be ſupported by that hiſtory.

Sir GEORGE BAKER mentions in the ſame paper the caſe of two pregnant women who were inoculated at Hertford. They both had the ſmall pox favourably, and

afterwards brought forth their children perfectly healthy at the uſual time. Both theſe children, at the age of three years, were inoculated with effect.

Sir GEORGE BAKER likewiſe mentions a caſe which fell under the obſervation of Dr. CLARKE of Epſom. "A wo-
" man towards the end of her pregnancy had the ſmall
" pox, from which ſhe narrowly eſcaped. Five weeks
" after the criſis ſhe was delivered of an healthy female
" child, who having numerous marks on her ſkin was
" judged by all who ſaw her to have undergone the ſame
" diſtemper before her birth. However, at the end of
" twelve months ſhe had the ſmall pox in a very ſevere
" manner. Both the mother and child were lately living
" at Epſom."

Since then we ſee that it is very probable, that the ſmall pox may be caught from the mother when ſhe is infected, it may be aſked, why does not this happen oftener? In anſwer to this we may ſuppoſe, that this is not ſo ready a way as when the child is expoſed to catch it after the birth, as we find too that a difference can be produced after birth; *viz.* inoculation is a much readier way of catching it than what is called the natural way. It may likewiſe be ſaid, that many women who are with child, and have the ſmall pox during pregnancy, do not recover; therefore both mother and child die before the diſeaſe can have time to produce eruptions upon the child.

child. Finally in many of thoſe caſes, where the mother recovers, there is ſometimes produced a miſcarriage, which alſo hinders the infection from taking place in the child. However, many women go through the whole diſeaſe, and the child ſhews no marks of the ſmall pox.

Thus have I ſtated facts relative to the preſent ſubject, with ſome of the beſt authorities on both ſides of the queſtion; and ſhall now leave the reader to form his own judgement.

IX. *Ett kort utdrag af en Journal, hållen på en reſa til och uti Kejſaredömet Japan, gjord af Doctor* Thunberg *åren* 1775 *och* 1776, *ſkrifvit til Herr* Joſeph Banks, *Præſes uti Royal Society, i* London [a].

Read Feb. 10, 1780.

NÄR min Herre, i början af innevarande år, under mit viſtande i London, behagade introducera mig uti åtſkillige ſälſkaper, der flere af Wetenſkaps Societetens reſpective Ledamöter voro tilſammans, gjordes mig åtſkillige frågor, angående det ſynnerliga landet Japan och deſs inbyggare, ſom jag då uti ſtörſta korthet hade den äran at beſvara; men för at vidare contentera ſå väl Societetens, ſom min Herres enſkilta nyfikenhet, adreſſerar jag til min herre detta mycket korta utdrag af den Journal, jag under mit 16 månaders viſtande i det aflägſna Japan hållit.

Det är min Herre förut bekant, at jag af Commiſſarierne öfver Hortus Medicus och några andre förnäme Herrar i Amſterdam blef utſkickad förſt til Cap de Bonne Eſperance och ſedan til Japan, at göra uti Hiſtoria natu-

(a) For a tranſlation of this paper ſee the Appendix.

rali

rali nya uptäkter, och at deraf öfverſända lökar och frön, ſamt lefvande träd och buſkar. Jag uppehöll mig try års tid på Cap de Bonne Eſperance, et ſtälle, ſom fournerade mig ganſka många nya, både Djur och Växter, och gick derifrån år 1775 til Batavia, hvarifrån jag kort derefter, nemligen den 21 Junii, afſeglade til Japan på Holländſka Compagniets ſkjep Staveniſſe, i följe med et annat ſkjep, kalladt Blyenburg. Reſan fortſattes, ſom vanligt ſker, förbi Pulo Sapato, Chineſiſka landet och Formoſa, igenom ſundet der och Japanſka Golfen, til Nagaſaki hamn, ſom är den endaſte i hela riket der något ſkjep har frihet at inſegla.

Vi utſtodo flera ſvåra ſtormar, hvaraf det medföljande ſkjeppet Blyenburg blef ſå illa medfarit, at ſedan masterne blifvit förlorade, det ej kunde fortſätta reſan til Japan, utan nödgades löpa in til Canton, at der repareras, och ſedan gå tilbaka til Batavia.

Den 13 Auguſti fingo vi Japan i ögnaſigte, och kommo in uti Nagaſaki hamn dagen der efter. Vi inſeglade uti hamnen med ganſka många uphiſſade flaggor, och låſſade våre Canoner vid det ſå kallade Papenberget, vid Kejſarens och Kejſarinnans vagter och före Nagaſaki ſtad. Under inſeglandet kommo om bord tvänne Öfver-Banjoſer, åtſkillige Tolkar och under officerare, ſamt några Committerade ifrån Holländſka Factoriet.

Öfver

Öfver Banjoſerne, ſom kunna jämnliknas med Mandarinerne i China, gingo ſtraxt at ſitta på et ſtälle, ſom var til den ändan tilredt, mitt på Skjepsdäcket, hvilket ſäte de ſedan altid nyttjade, ſå ofta de viſtades om bord. Deſſe Officerare, ſom växlas om, äro altid om bord de dagar, då ſkjeppet loſſas eller laſtas, och ingen ting får föras hvarken til eller ifrån ſkjeppet, under all den tid det ligger i hamnen, utan at de äro tilſtädes. De äga upſigt öfver alt det, ſom går ut eller in i ſkjeppet: för deras ögon viſiteras både folck och gods: framför dem mönſtras hvarje gång alt ſkjepsfolcket: de förläna och undertekna alla paſsporter, och göra dageligen rapport af alt, hvad ſom förefaller, til Gouverneuren i Nagaſaki.

Det förſta, ſom förekom oſs underligt och ovanligt, var den ſtarka viſitation, ſom hvar och en perſon, och alt det gods, ſom fördes til eller ifrån ſkjeppet, måſte undergå. Denna viſitation förrättades icke allenaſt ganſka noggrant, utan den ſkjedde dubbelt, nämligen både på ſkjeppet och i land. Sängkläderne upſprättades, och ſjelfva fjädrarne i dem ranſakades: kiſtor utpackades ända til botn, och ſjelfva plankorne i dem klappades på alla ſidor, til at uptäcka, om in uti dem voro några hemliga gjömmor: ſmörpottor och confitur-krukor rördes inuti med en jernſpits: uti oſtar ſkars förſt et ſtort hål, och ſedan ſtacks en knif in åt alla ſidor: ja de miſſtrodde ſjelfva äggen och ſlogo

äfven deraf åtſkillige i ſtycken. Hvarje perſon, ſom går ifrån eller til ſkjeppet, viſiteras äfven lika ſkarpt. Viſitatorn ſtryker med ſina händer längs ryggen, ſidorne och magen, ända ned til knän, ſå at ingen ting på lifvet kan gjömas, utan at han uptäcker det. Denne viſitation måſte nu alla, utan åtſkilnad, undergå, ända ifrån Chefen intil den ſämſta matros, enligt de ordres, ſom år 1775 ankommo ifrån Kejſerliga Hofvet.

Tilförene var denna viſitation icke allenaſt mindre ſträng, utan Chefen och ſkjeps Capitenerne voro aldeles frie ifrån den ſamma, och Capitenerne hade då tilfälle, at lurendräga in ſå mycket gods, de ville, til hvilken ända de voro klädde i en ganſka ſtor och vid öfverråck, med tvänne ſtora ſäckar eller fickor på inre ſidorne, ſom fyldes med contraband-varor, när de gingo til eller ifrån land, hvilcket ſkjedde gemenligen trenne gånger om dagen.

Orſaken til denna ſtränga viſitationen äro Europæerne ſjelfve, ſom ifrån den ena tiden til den andra, med ſine lurendrägerier retat Japanſka Regeringen, til at mer och mer inſkränka deras frihet; och då den ſamma länge nog märkt, at ju nogare de viſiterades, ju finare de öfvade ſine bedrägerier, ſå har den omſider tagit deremot ſådane mått och ſteg, at nu mera för den aldrafinteligaſte icke en enda utväg mer är öfrig til oloflig handels drifvande. För några år ſedan hade en ſkjeps

under-officerare in uti ſjelfva byxorne fördöljt en fogel, i tanka at ſälja den ſamma, då han kommit i land; men under ſjelfva viſitationen, til olycka, begynte foglen at ſjunga och bedrägeriet uptäcktes: ſedan den tiden viſiteras utanpå hos Matroſerne och ſämre folck byxorne, och ſjelfva håret på Slafvarne.

Japoneſen är til färgen gulagtig, ehuru man ibland finner några, i ſynnerhet Fruntimren, ſom äro mycket hvita. De ſkiljas ifrån alle andre nationer, undantagne Chineſen och Tartaren, med ſine djupe och aflånge ögon ſamt höga ögonbryner. Näſan är ej platt, ehuru hon är något tjockare och kortare, än på en Europé. Håret är ſvart, och upſättes på enahanda vis, ſå at en främling här icke utan ſtörſta förundran, anſkådar et almänt mode, ſom uti hår-friſure och klädning, hos en hel nation, är oförändradt, ända ifrån Kejſarens Thron intil den lågſta koja.

Männerne upſkicka ſit hår på helt annatt ſätt, än andra könet: hela förhufvudet och midden ända til nacken afrakas aldeles, och hålles äfven ſå frit för hår, ſom hakan ifrån ſkjägg; det öfriga, ſom är vid tinningarne och i nacken, upſtrykes och bindes öfver hjeſſan tilhopa med en hvit tråd; utom denna bindningen lämnas håret ſå långt ſom en finger, och klippes der tvärtaf, ombindes

med reſten af förra tråden, och böjes emot hufvudet, lika ſom en krokig finger.

Andra könet behåller alt ſit hår, utan at deraf afraka något. Håret upſtrykes emot kullen och viras der tilhopa i en knut, ſamt utdrages åt ſidorne i tvänne breda vingar: bakom knuten ſättes en kam, och igenom knuten åtſkillige långa zirater utaf olika ſkapnad och ämne.

Medici och Präſter, ſom gemenligen låta raka hela hufvudet, och barn, ſom ej ännu hunnit til manlig ålder, äro de endaſte, ſom göra i detta modet något undantag, til at ſkilja ſig ifrån de öfriga af nationen.

Hela nationen har enahanda och ſin egen ſärſkilda klädedrägt, ſom ifrån urminnes tider varit oförändrad. Den beſtår uti en eller flere Nattråckar, ſom bindas til om lifvet med et bälte. Fruntimren hafva gemenligen deſſe längre, och ofta ſläpande efter ſig. Deſſe nattråckar äro om ſommaren ganſka tunna, och om vintren upſtoppade med tjock ſilke-eller bomuls-wadd. De förnäme nyttja härtil ſilke, och de fattige bomuls tyger. Fruntimren nyttja deraf gemenligen et ſtörre antal, och äga dem prägtigare, ofta med inväfne guld-och ſilfver blomor.

Nattråcken är vid bröſtet något öpen, och har mycket vida armar, hvars öpning framtil är til hälften ihopſydd, och formerar en ſäck, innom hvilken de kunna indraga

händerne,

händerne, och i hvilken de kunna bevara papper och andre ſaker, lika ſom i en ficka. Männerne hafva utom deſs en mantel eller half nattråck, ſom räcker til höften, af ganſka tunt, ſvart tyg, och utan på nattråcken långa byxor, ſom mycket likna en fruntimmers kjortel, öpen ganſka långt ned på bägge ſidor. Med deſſe tvänne ſednare ſkiljes bättre folck ifrån den ſämſta pöbelen. Många nyttja underbyxor utaf linne, men benen äro altid nakne. De bruka aldrig ſkor, utan endaſt toflor af halm flätade, förſedde med en bögel och et band, ſom ſtickes emellan ſtortån och den näſta tån, til at hålla dem faſt. Endaſt i vintren bruka de ſåckor af linne på fötterne. När det är mycket orent och regnväder, nyttja de höga träſkor. Hufvudet betäckes aldrig, om icke de äro på reſor, då de nyttja en coniſk hatt af halm; utan de bruka ſolſkärmar (paraſols) at ſkydda hufvudet för ſtark ſolhetta och regn.

Uti bältet, ſom om lifvet faſthåller nattråcken, inſättes ſabelen, ſolfjädren och tobakspipan. Sabelen inſtickes på vänſtra ſidan, ſå at ſkarpa äggen altid vetter upåt. De, ſom äro uti någon public tjänſt, draga altid tvänne ſablar, hvaraf den ena altid är längre.

Huſen byggas af träſtolpar, ſom på någon diſtance inhuggas i hvarandra, näſtan ſom på korsverkshus; emellan deſſe flätas ſönderklyfde bambokäppar, och på ymſe

ſidor

ſidor af dem beſtrykes lera och hvitlimmas, ſå at de likna et ſtenhus. Våningarne äro ofta tvänne, hvaraf den öfverſta är lågare, och nyttjas ei ſå almänt til boning. Taken äro merendels täkte med ſtora och tunga, faſtän vackra och väl gjorda pannor af blå lera. Golfvet, ſom altid är uphöjdt en aln ifrån jorden, belägges med bräder och ofvan på dem aflånga mattor, flätade och fylde med halm, utaf try eller fyra fingers tjocklek. Hela huſet utgör et enda ſtort rum, ſom ſedan kan afdelas i ſå många ſmärre kamrar, ſom de behaga, med rammar, ſom inſättas i dertil inrättade träbjälkar, ſom ſå väl uptil under taket, ſom nedtil på golfvet, blifvit inlagde. Sådane rammar äro gemenligen öfverdragne med tjockt måladt papper, och likna våre tapeter. Fönſtren beſtå äfven af rammar, afdelte i ſmå rutor, och påkliſtradt hvitt, ganſka tunt papper.

Man finner aldrig några meubler uti Japoneſens hus, hvarken ſpeglar eller väggur, ſkåp eller bureauer, ſtolar eller bord, kakelugnar eller ſpiſar, ſoffor eller ſängar. Deras ſed är, at ſitta ned på de mjuka och ſnygga golfmattorne, läggande ſina fötter under kroppen, ſå at deras egna hälar blifva deras ſtol. Under måltiderne framſättes hvarje rätt ſärſkild, äfven på deſſe mattor, dock på et litet, knapt try eller fyra tums högt bord. Speglar, ſom de likväl ej upſätta i huſet til någon prydnad, göra de

af

af en componerad metall, ſamt nyttja dem endaſt vid hårets uplägning.

Spiſar och kakelugnar äro hos dem aldeles obekante, faſtän den ſtränga blåſten och kölden tvingar dem, til at värma ſina hus ifrån Novembris til Martii månad; men i deſs ſtälle nyttja de ſtora koppargrytor med breda flata bräddar och fötter, hvilke inſättas i rummen, på ſjelfva golfvets halmmattor. Deſſe grytor beklädas in uti med lerbruk, och fyllas til en del med ren aſka, hvarpå väl utbrända furukol upſtapplas, ſom i brand ſtukne upvärma rumet, utan at oſa.

Tobakens bruk har utan tvifvel hos Japoneſerne blifvit förſt bekant igenom Portugiſerne; men faſtän bägge könen här röka och äfven ungt folck, ſå ſkjer dock ſådant mycket ſparſamt. När de vela ſägna en ankommen främande, ſå är gemenligen tobakspipan och en kopp thévatn det förſta, ſom bjudes honom. Pipan beſtår af et kortare eller längre väl gjordt träſkaft med munſtycke och hufvud, utaf mäſſing eller hvit koppar. Sjelfva hufvudet är ej ſtörre, än at det kan ryma en ſtor ärt, och ſjelfva tobaken, ſom är fulkomligen torr, karfvas ſå fin, ſom hufvudhår, utaf en fingers längd: den måſte altſå vridas ihop likſom til en pill, för at kunna ſtoppas i piphufvudet. När den blifvit ſtucken i brand, är pipan

lätteligen

lätteligen och med några få drag utrökt. På detta ſätt röka de flere pipor å rad, ſamt utblåſa röken långſamt igenom näsborrorne.

Solfjädren nyttjas utaf bägge könen, at dermed i hettan ſvalka ſig, och är derföre altid både innom och utom hus deras trogna följeſlagare.

Hela nationen är fallen för ſnygghet och renhet; man finner derföre uti hvarje hus, och uti alla herberg för reſande en badſtuga, der de hvarje dag, utan förſummelſe, tvätta ſig.

Sällan eller aldrig får man ſe någon mansperſon, ſom icke har ſina kläder teknade med ſit ſigils märke, hvilket med ſamma färg, hvarmed tyget blifvit trykt eller färgadt, på ſmå dertil på armar och rygg hvite lämnade runde fläckar blifvit teknat, och gör, at ägaren altid igenkänner ſin klädning, ſkjönt den funnos lagd ibland hundrade andra.

Hörſamhet och lydnad emot föräldrar ſamt ödmjukhet emot förmän i agt tages här på det alranogaſte. Det är nöjſamt at ſe, med hvad reſpect, ſom en förnäm och en Ämbetsman bemötes. De ſtadna icke allenaſt, om de möta en ſådan, eller om han råkas i något hus, hålla ſig på längre afſtånd ifrån honom, utan böja äfven ſine hufvuden ända ned til jorden. Vänliga äro de altid emot hvarandra,

hvarandra, i hälsningar, tal och åtbörder. Barnen vänjas härvid ifrån förſta barndomen, och föräldrarne föregå dem med fit exempel. Aga och ſtraff äro ſälſynte i landet, men lagar och ſtraff ganſka ſtränga. Människjor äro väl af naturen på alle orter benägne til ondt, men knapt gifves något land, der mindre förbrytelſer ſkje emot landets lagar.

Uti deras namn är någon ting, ſom förtjänar upmärkſamhet. Stam-namnet nyttjas aldrig i dageligt tal, utan endaſt, då de underteckna någon ſkrift. Med förnamnet åter nämnas och ropas de i dagligt tal, och det ſamma förändras efter deras olika åldrar och efter olika ſyſlor, ſom de med tiden beklädа, ſå at de i ſin lifstid ibland ägt fem eller ſex ſärſkilde förnamn, faſtän familie namnet altid varit oförändradt.

Sin ålder räkna de altid jämnt med det året, på hvilket de varit födde, antingen det ſkjett i början eller ſlutet: ſåledes räknas et barn altid årgammalt, ſå ſnart nyårsdagen infaller, änſkjönt det kommit til verlden endaſt några dagar förut.

Handel och flögder äro hos Japanſka nationen i flor, faſt icke i den grad, ſom i Europa; ty deras behof äro ej ſå många: men Åkerbruket är hos dem uti ſtörſta värde, ſå at man här ſer jordytan öfver alt, och de mäſte bergen

ända up til topparne upbrukade. Utrikes handel drifva de endaſt med Holländſka och Chineſiſka Compagnierne. Emot Koppar och rå Campher, ſom Holländaren utförer, återtaga de Puderſocker, Modernäglickor, Sappanträ, Elfenben, tenn, bly, ſkilpadſkal, Chitſer, Taffecelastyger och några andre ſmåſaker.

Som Holländſka Compagniet i Japan aldeles icke betalar någon tull för ut-eller in-gående varor, ſå ſändas i det ſtället årligen ſkänker til Hofvet, ſom beſtå i kläden, Chitſer, Succotas, bomulstyger och ſtundom några rariteter. På denna reſa, ſom förrättas endaſt af trenne Europæer och vid paſs tvåhundrade Japoneſer, hade jag det nöjet, at följa Ambaſſadeuren til den längſt bort i landet belägna Hufvudſtaden Jedo.

Den 4 Martii 1776 afreſte vi ifrån vår lilla ö. Dezima och Nagaſaki ſtad igenom Kokora til Simonoſeki, der vi den 12 gingo om bord på et för oſs tilredt ſtort fartyg, hvarmed vi innom ſkärs affeglade til Fiogo. Reſan fortſattes vidare öfver land til Oſacca, en af de förnämſta handelsſtäder i Riket, der vi tilbragte den 8 och 9 Aprilis. Innom en dags reſa ankommo vi den 10 derpå följande til Miaco, Andeliga Kejſarens Hufvudſtad. Här förtöfvade vi tvänne dagar, och påſkyndade vår reſa til Hufvudſtaden Jedo, dit vi lyckeligen anlände den 1 Maji.

Reſan til lands ſkjer altid uti Norimons, en ſort af Palanquins, ſom äro tilſlutne och förſedde med fönſter, ſamt bäras utaf flere män. Skänkerne få väl ſom dageliga Provianten bäras äfven af folck uti kiſtor, och några få ſaker föras på packhäſtar. Officerare och Tolkar ledſaga oſs, och beſörja om all ting, ſå att vi kunna göra en nöjſam och obekymrad reſa.

Den 18 Maji var den dag, då vi hade hos Cubo, eller verldſliga Kejſaren, hos Kronprinſen och de tolf Rikſens Råd vår audience; dagen derpå hos Tempelherrarne, ſom föra ſtyret öfver kyrkorne, och Stadens Gouverneurer med flere. Den 23 påföljande hade vi vår afſkjeds audience, afreſte från Jedo den 26 Maji, och ankommo til Miaco den 7 Junii. Nu på återreſan hade vi här den 8 Junii audience hos Kejſarens Ståthållare, ſom äfven får några ſkänker, efter vi aldeles icke få aflägga något beſök hos Dairi. Den 11 fingo vi tilſtånd, at vandra uti och ikring Staden, at beſe deras kyrkor och ſtörre hus; men afreſte emot aftonen derifrån til Oſacca. Denna vackra och för ſin handel väl belägna ſtad fingo vi frihet at genomvandra den 13, och at beſe deſs kyrkor, comœdier, andre märkvärdigheter, och i ſynnerhet huru kopparen ſmältes, ſom endaſt ſkjer i denna ſtaden, och ei på något annat ſtälle mer i Riket. Hos Stadens

Gouverneurer hade vi den 14 audience, och fortſatte ſedan vidare vår reſa til Fiogo. Efter vanligheten gingo vi här på et ſtort fartyg den 18 om bord, at ſjövägen afgå til Simonoſeki och Kokota, dit vi ankommo den 23. Sedan blefvo vi uti Norimons burne til Nagaſaki och vårt lilla factorie på Öen Dezima, hvareſt vi ſlutade den ſiſta Junii vår Ambaſſade, efter 118 dagars reſa.

X. *Account of an extraordinary Appearance in a Miſt.* *By Mr.* William Cockin; *communicated by* Joſeph Banks, *Eſq. P. R. S.*

Read Feb. 20, 1780.

Lancaſter, Sept. 2, 1777.

JANUARY 13, 1768, betwixt nine and ten in the morning, being on an eminence that overlooked ſome low meadow ground, I obſerved, in a direction oppoſite to that of the ſun, which ſhone very bright, and in a miſt which covered the ſaid incloſures, an unuſual meteor, which, without attempting to name it, I ſhall deſcribe as well as I can by the help of the following figure.

At about the diſtance of half a mile, and incurvated towards each other, like the lower ends of the common rainbow, there appeared in the miſt two places of a peculiar brightneſs as repreſented at AA. They ſeemed (as is common) to reſt upon the ground, were continued as high as the miſt, and in breadth, perhaps, near half as much more as that of the iris. In the middle, between theſe two places, on the ſame horizontal line, was a coloured

loured appearance like *d c b*, *a*, *b c d*, whoſe baſe could not at moſt ſubtend an angle of above ten or twelve degrees, and whoſe interior parts were thus variegated. The center *a* was dark and irregularly terminated, as if made by the ſhadow of ſome object not bigger than an ordinary ſheaf of corn. Next this center was a curved ſpace *b b*, of a yellowiſh flame colour. To this ſucceeded another curved ſpace of nearly the ſame dark caſt as the center, ſeemingly tinged with a faint hue of green, and very evenly bounded on each ſide, as is ſhewn at *c c*. After theſe came on the terminating ring, which was coloured very much in the manner of the common rainbow, except that the tints were not quite ſo vivid (as if owing to the effect of a yellowiſh tinge, which ſeemingly entered into the compoſition of all the colours) nor their boundaries ſo well defined. The center of the image appeared to be exactly in the line of aſpect (as it is called) or one conceived to be drawn from the ſun through the eye of the ſpectator; and it may be obſerved from the figure, that theſe curve ſpaces were not ſegments of perfect circles, but formed like the ends of concentric ellipſes, whoſe tranſverſe axiſes were perpendicular to the horizon.

To the above deſcription of the image it may be neceſſary to add the following particulars which attended it.

The

The miſt was very thick near the ſurface of the meadows, though rarer upwards, and chiefly, if not ſolely, on the ſide of the hill oppoſite to the ſun. The place where I ſtood was juſt on its confines; and I found, as I advanced into it, that the object became gradually fainter and fainter. As the ſun diſperſed the vapour, the appearance faded proportionably; and about half an hour after I firſt ſaw it, it was ſcarcely viſible. The evening before was wet; but the drops on the hedges were congealed by froſt. Where the ſun ſhone the buſhes were each inveſted with a miſt, as if owing to the vapours exhaled from them by the ſun's warmth; and, on a nearer inſpection (for there was ſomething ſingular in this appearance), I was rather ſurprized to find, I could clearly diſcern the little humid particles which occaſioned it, and which were floating around the buſhes at about half an inch diſtance from one another.

Such were the moſt material circumſtances of this beautiful and ſingular appearance. Singular no doubt it is, as we have only two inſtances of a like kind mentioned in Dr. PRIESTLEY's Hiſtory of Light and Colours. The firſt is given by M. BOUGUER as ſeen upon the Andes[a];

(a) This is deſcribed as ſeen in a cloud conſiſting of frozen particles, and at about thirty paces diſtance. All the parts of the obſerver were clearly ſhadowed out, as legs, arms, and head, about which laſt parts the coloured circles were formed. It is farther noted, that the intervals between the circles continued equal, though their diameters were conſtantly changing.

and

and the other by Dr. MACFAIT as ſeen in Scotland[b]. A third, however, may be met with as obſerved at Pambamarca[c], in ULLOA's Voyage to South America.

It is the pleaſure of philoſophy to attempt ſomething by way of ſolution concerning every extraordinary fact which falls under its cognizance: and though it be not always ſo happy as to produce ſatisfaction, it may at leaſt ſucceed in the way of amuſement. Under the influence of theſe notions, let us ſee what offers reſpecting the philoſophy of the curious appearance before us.

With regard to the elliptical form of the curve ſpaces, as it cannot be accounted for from refraction, I apprehend it is owing to the oblong figure of the obſerver's ſhadow, which is very evidently the dark part in the middle, and to which the coloured marginal rings are in ſome ſort obliged to conform. The bright places AA correſpond to an appearance once obſerved by Dr. SMITH[d], and which he very plauſibly attributes to a confuſed mixture of the principal reflected beams

(*b*) This was ſeen in an extremely thick fog or miſt. The interval correſponding to *bb* was obſerved to conſiſt of colours ſimilar to, though fainter than, thoſe of *dd*.

(*c*) The apparent diſtance is here placed at about ten toiſes. The vapours are ſaid to be of a tenuity cognizable by the ſight. The gradual change of the diameter of the rings is mentioned; as alſo, that they appeared at firſt to be of an elliptical figure.

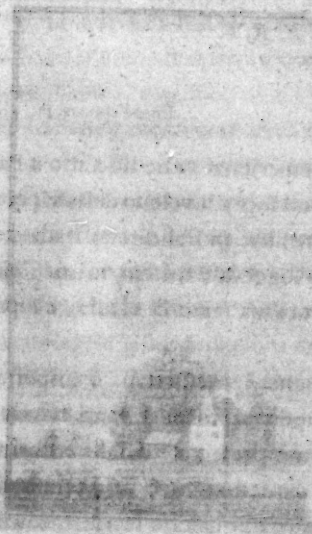
(*d*) See Art. 502. of the remarks at the end of his Optics.

that exhibit the ordinary bow. This muſt be owing to ſomething peculiar in the miſt, as to the form, ſize, &c. of its particles or globules; eaſier to conceive than explain. In the valuable Treatiſe of Optics by the laſt named gentleman, there is an account of Dr. PEMBERTON's theory for the ſlender rings of colours, which are ſometimes ſeen within the rainbow, which Dr. LANGWITH firſt deſcribed in the Philoſophical Tranſactions (*e*), and from which ſome idea may be formed of the cauſe of the coloured part of the image. It is in ſubſtance this (*f*). If the drops of rain, &c. which the ſun ſhines upon be exceedingly ſmall, from the irregular reflection of all ſurfaces, and the fits of eaſy tranſmiſſion, which the diſſipated rays may undergo in their paſſage through thoſe little globules, there may naturally be formed other coloured arches within the common bow for a number of ſucceſſions. Hence, with regard to the inſtance in queſtion, ſince its rings were ſo very ſmall in diameter, it appears, that on ſome account or other the refracted, coloured, and diſſipated rays alluded to, have in their return to the eye nearly made the ſmalleſt angles poſſible with the lines of incidence.

(*e*) N° 375.
(*f*) See Articles 506, 507.

After all, this is only to be conſidered as conjecture. Though it does not want analogy, we have not had it yet properly aſcertained by experiment: and hence it is not without reaſon, that Dr. PRIESTLEY conſiders the additional rows of colours within the common rainbow obſerved by Dr. LANGWITH, and thoſe of the ſpecies of image here deſcribed, as one of the *deſiderata* of optics.

J. BASIRE. SC.



XI. *Memoria ſopra il Veleno Americano detto Ticunas. By the Abbé* Fontana, *Director of the Cabinet of Natural Hiſtory belonging to his Royal Highneſs the Grand Duke of* Tuſcany; *communicated by* John Paradiſe, *Eſq. F. R. S.* (a)

Read February 17, 1780.

LE eſperienze, che ho fatto a Parigi fino da due anni ſono ſopra il veleno della vipera, che fanno il ſeguito di molte altre pubblicate in Italia 10 anni prima ſul medeſimo ſoggetto; mi hanno meſſo in ſtato di pronunciar con ſicurezza ſopra la natura, e ſopra le proprietà di quel veleno.

Gli effetti inaſpettati, e importanti, che ho oſſervato applicando ai corpi viventi il veleno di quell' animale, mi hanno preſentate delle verità nuove per la fiſica animale; e queſte nuove verità mi hanno condotto per gradi a dubitare di qualche teoria medica non abbaſtanza provata, o troppo generalizzata dalle perſone dell' arte.

Fin d' allora ho deſiderato di portar le mie ricerche ſopra qualche altro veleno, e ſe foſſe ſtato poſſibile avrei

(a) For an Engliſh tranſlation of this paper ſee the Appendix.

deſiderato di eſaminar qualche veleno vegetabile de piu attivi. Mi figuravo, che i veleni animali, foſſero comme è il veleno della vipera, per eſempio, che applicato ad una ferita ſi diffonde ben ſi nel corpo dell' animale, ma non viene aumentato per queſto, come è aumentato per contrario il veleno, che eccita il vajolo, o la rabbia del cane; mi figuravo diſſi, che quei veleni aveſſero molta analogia fra loro, e che agiſſero nella medeſima maniera; e ſopra le ſteſſe parti dell' animale.

Per l'oppoſto non oſavo congetturar nulla ſopra l'azione dei veleni végétabili, che non avevo ancor eſaminati, e nulla mi pareva di potere avanzar con ſicurezza ſopra l'azione di eſſi, anche dopo la lettura de principali ſcrittori di quei veleni. La lor maniera di ſperimentare era molto diverſa da quella, che io avevo tenuta nell' eſaminare il veleno della vipera, e le loro illazioni mi parevano troppo vaghe e incerte. Arrivato a Londra potei facilmente ſodisfare ai miei deſideri ſu di queſto. Il Dr. HEBERDEN, celebre medico in Londra, e membro della Società Reale; mi ha procurato un gran numero di freccie Americane ben conſervate, e ben coperte di veleno, e di piu ha avuta la gentilezza di farmi avere una buona quantità di veleno, che era chiuſo, e ſigillato dentro un vaſo di terra, il quale aveva per di fuori una cuſtodia di latta. Nella cuſtodia di latta vi era un foglio, in cui ſi

leggevano le seguenti parole: *Indian Poison brought from the Banks of the River of Amazons, by Don* PEDRO MALDONADO; *it is one of the sorts mentioned in the Phil. Transf. vol. XLVII. n.* 12. Nel volume citato delle Transazioni vi si parla di due veleni poco differenti nella loro attività. L'uno detto Lama, e l'altro Ticunas. Il veleno del vaso di terra da me adoprato è il Ticunas Il veleno delle Freccie non si sa bene a qual dei due appartenga, ma per esperienza l'ho trovato della medesima forza del Ticunas; onde non credo punto importante di distinguer l'una sorta dall' altra.

Molte cose si sono scritte dell' attività di questi veleni Americani dagli autori, talchè ho creduto bene di dover cominciar le mie esperienze per gradi, prendendo tutte le precauzioni possibili. Il semplice odorarlo si crede nocivo, all' aprir solo il vaso, e a'l solo diffonderſi di qualche molecola per l'aria si teme di qualche grave male, e fino la morte: così almeno si legge ne migliori autori.

Cominciai adunque subito aperto il vaso del veleno di far respirar di quell' aria ad un tenero piccione, e lo tenni col capo dentro il vaso per piu minuti. Lo levai di là che stava così bene che prima. Staccai con uno scalpello molti pezzi del veleno, perchè si eccitasse un poco di polvere nel vaso, e allora vi immersi di nuovo il capo del Piccione,

Piccione, che non ſoffrì nulla ne anco in queſta ſeconda eſperienza.

Da queſto momento non ebbi piu alcuna difficoltà di eſpor me medeſimo a quel vapore, e di ſentirne l'odore, che mi parve nauſeoſo, e ingrato. Molte particelle mi entraronno coll' aria in bocca, e trovai che avevano un ſapore ſimile in qualche coſa alla liquirizia. L'odore adunque di queſto veleno a ſecco e affatto innocente, e innocenti ſono le molecole, che entrano coll' aria nella bocca, o nel naſo, e che vanno al polmone.

Ma dove par che piu ſi tema queſto veleno, benchè ancora eſterno, e allora che ſi riduce in vapori bruciato ſu' i carboni, e ridotto in fumo, o che e bollito lungamente, e inalzato in vapori denſi. Nell' uno, e nell' altro modo ho voluto provarlo. Ho gettato piu pozzetti del veleno ſecco ſopra i carboni acceſi, ed ho fatto che il Piccione reſpiraſſe quel fumo, tenendolo colla teſta nel mezzo di eſſo; il Piccione non ha mai dato ſegno di patir nulla. Ho fatto di piu: ho fatto entrare quel fumo in un tubo di vetro alto 6 pollici, e largo quattro. Il tubo era tutto ripieno di un fumo denſo, e bianco, vi ho introdotto il ſolito Piccione, che non ha moſtrato di ſoffrir di piu che ſe l'aveſſi introdotto nel fumo di zucchero brucciato. Son paſſato in ſequito a farne bollire una buona quantità dentro un vaſo di terra. Ho eſpoſto ai vapori di

eſſo

esso il Piccione; ve lo ho esposto quando già il veleno cominciava, a divenir consistente; vè lo ho esposto quando già fatto anco piu sodo cominciava a bruciare ai lati del vaso, e a ridursi tutto in vapori densissimi, e in carbone; l'animale non soffrì nulla a nessuna di queste pruove; e allora fu che non ebbi neppur' io alcuna difficoltà di odorarlo, e di espormi a quei fumi. L'odore del veleno secco che brucia su i carboni è molto disgustoso, e sente l'odore di sterco bruciato.

Ne deduco da tutte queste esperienze, che i vapori, o fumi del veleno Americano odorati, o respirati sono innocenti. M. DE LA CONDAMINE è stato certamente ingannato, quando ha scritto, che questo veleno si prepara da donne condannate a morte, e che allora si conosce, che è arrivato alla sua perfezione, quando i vapori, che manda nel bollirlo, uccidono la persona, che e obligata ad esser presente.

Questo veleno si scioglie facilmente e bene coll' acqua anche fredda, come ancora con gli acidi minerali, e vegetabili. Nell' olio di vitriolo però si scioglie molto piu tardi, che negli altri acidi, e diventa nero, come l'inchiostro, che non succede con nessuno degli altri acidi. Non fa alcuna effervescenza nè cogli acidi, nè con gli alcalini, e non altera punto il latte, nè lo tinge, se non che del suo color naturale. Non altera il succo di radici, nè in roseo,

nè

nè in verde; ed esaminato col microscopio nulla si vede di regolare, e di salino, ma bensì par fatto in gran parte di corpicciuoli minimi irregolari rotondastri a somiglianza dei succhi vegetabili. Si dissecca, senza screpolare, a differenza del veleno della vipera, e messo sulla lingua ha un sapore estremamente amaro.

Da tutto questo ne deduco, che non è nè acido, nè alcalino, e che non è composto di sali visibili, nè anco al microscopio.

Non tanto la curiosità quanto l'ordine, che mi ero prefisso nel far le mie esperienze, mi portarono ad esaminare, se questo veleno era micidiale applicato immediatamente sopra gli occhi, o se vi eccitava qualche malattia, o irritazione. Avevo già prima trovato, che il veleno della vipera era affatto innocente messo sugli occhi, come lo è per la bocca, e per lo stomaco; onde ero curioso di vedere i rapporti fra questi due veleni sì attivi, e sì diversi nella loro origine.

Cominciai adunque a metterne una picciola quantità sciolta nell' acqua, sopra l'occhio d'un porchetto d'India. L'animale non mostrò di soffrir nulla nè allora, nè poi, e l'occhio non s'i infiammo punto. Ripetei l'esperienze dopo due ore sopra tutti due gli occhi del medesimo animale, e vi applicai una maggior quantità di veleno; il porchetto d'India non soffrì il piu picciolo incomodo, e gli occhi si

mantennero

mantennero nel loro ſtato naturale. Rinnuovai l'eſperienza ſopra gli occhi di due altri porchi d'India col medeſimo eſito; e il medeſimo eſito ebbero tutte le eſperienze, che feci in ſeguito ſopra gli occhi di molti altri animali, e ſpecialmente ſopra gli occhi dei cunigli. Non potei mai oſſervare alcuna alterazione de loro occhi, o che quel veleno gli incomodaſſe di piu di quel che avrebbe fatto l'acqua, ſe gli aveſſi bagnati con eſſa; onde credo di poter concludere, che il veleno Americano non è punto veleno meſſo ſugli occhi, e che non ha alcuna azione ſopra di eſſi.

Ma ſarà egli innocente preſo per bocca, e inghiottito? M. DE LA CONDAMINE, e tutti gli altri, che hanno parlato di quel veleno lo credono affatto innocente preſo per bocca e tale è l'opinione comune di tutti gli Americani. La ragione che lo ha fatto creder tale ſi é, che ſi poſſono mangiare impunemente gli animali uccíſi con quel veleno o per meglio dire colle freccie avvelenate. Queſta ragione è piu ſpecioſa che convincente, perchè potrebbe eſſer veleno introdotto nel ſangue anche in piccoliſſima quantità, e non eſſerlo, ſe non che in una maggior doſe quando è preſo per bocca.

Ecco le eſperienze che ho fatto, le quali ſervono ancora a renderci cauti prima di pronunciare anche dopo che ſi è conſultata l' eſperienza medeſima.

Feci inghiottire due grani di veleno sciolto nell' acqua ad un piccolo coniglio e la sforzai in seguito a bere un cucchiajo da Tè di acqua per dilavar la bocca, e per scendere tutto il veleno nello stomaco. Questo animale non mostrò di soffrir nulla, ne allora, nè dopo.

Feci bere ad un altro piccolo cuniglio, come sopra, trè grani di veleno, e non soffrì nulla, come il primo. Ad un altro piccolo cuniglio feci bere quattro grani di veleno, e non ebbe nulla neppur' esso. Le medesime esperienze feci sopra trè piccoli cunigli, al terzo dei quali detti 6 grani di veleno, e non ebbe nulla, come tutti gli altri.

Credevo, che queste esperienze potessero bastare, per afficurarmi, che il veleno Americano è innocente preso per bocca, come lo è il veleno della vipera, ma mi sarei ingannato. Ebbi la curiosità di provarlo sopra un piccolo piccione; gli detti a bere 6 grani di veleno, e morì in meno di 20 minuti. Replicai l'esperienza sopra due altri piccioni, e morirono tutti due dentro 30 minuti.

Queste ultime esperienze, che par che contradicano le prime, mi hanno obbligato di ripeterne molte altre di nuovo sopra i conigli, e sopra i porchi d'India. Detti adunque a bere cinque grani di veleno ad un piccolo porchetto d'India, e lo trovai morto dopo 25 minuti. Feci bere circa 8 grani di veleno ad un altro piccolo cuniglio; e questo dopo 30 minuti pareva che non avesse nulla:

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ma dopo altri 30, cominciò a reggersi male su i piedi, dope altri 4 cadde come morto, e dopo altri quattro era morto affatto. Ad altri due piccoli conigli, e ad altri due porchetti d' India feci bere circa 9 grani di veleno. Un cuniglio morì in meno di 45 minuti, e in 20 minuti erano morti i due porchetti d'India. Questi risultato mi fecero credere, che una piu gran dose di veleno poteva produrre piu sicuramente la morte, e che l'istessa quantità di veleno produceva degli effetti diversi nei medesimi animali, secondo lo stato nel quale si trovava loro ventricolo. Avevo in generale osservato nel far le esperienze sudette, che gli animali morivano piu difficilmente quando avevano lo stomaco piu pieno, o non soffrivano nulla inghiottendo di quel veleno. Volli farne la prova in tre cunigli, e in due Piccioni, che tenni lungamente digiuni. Muorirono tutti in meno di 35 minuti, con soli tre grani di veleno. Ripetei l'esperimento in altri 5 animali, come sopra, ma a stomaco pieno: non ne morì, che un solo.

Ne deduco, come una verità di fatto, che il veleno Americano preso per bocca è veleno, ma che se ne richiede una quantità sensibile per uccidere un animale anche piccolo. I fatti riportati sopra sul veleno Americano, che in piccola dose è micidiale, mi farebbono credere, che il veleno della vipera, che è innocente preso per bocca in piccola quantità, fosse poi mortale preso in mag-

gior quantità. Quel ſentimento di torpore che eccita ſulla lingua, e che dura ſi lungamente, par che baſti per non lo credere affatto inattivo, e che preſo in gran quantità potrebbe beniſſimo dar la morte. Mi reſervo di far queſta eſperienza in qualche altra occaſione, e allora farò uſo del veleno di 18, in 20 vipere, che darò a mangiare ad un piccolo animale a ſtomaco vuoto, e ardiſco preſagire d'avanza che probabilmente morra, perché ſe in piccoliſſima doſe toglie il moto, e il ſenſo alla lingua, cioè i principi della vita in quell' organo; una piu gran quantità dovrà torgli anche agli organi; i piu eſſenziali alla vita medeſima. Se ſi riflette, che preſo il veleno per bocca deve eſtenderſi ſopra una ſuperficie grandiſſima, ſempre umida, e meſcolarſi coi cibi del ventricolo, che i vaſi inalanti ſono minimi, non parrà piu ſtrano, che non nuoca quando è preſo in piccola quantità, come ſi vede appunto del veleno Americano.

Cominciai le mie eſperienze ſopra l'attività di queſto veleno col ferire con una lancetta imbrattata di veleno ſciolto nell' acqua, diverſe parti degli animali. Ferii con eſſa un piccolo porchetto d'India per tre volte nella coſcia a diverſe diſtanze. La lancetta era piena di veleno, ma l'animale non ſoffrì nulla. A trè altri piccoli porchetti, e ad un cuniglio feci le medeſime prove, e non ne morì neſſuno, nè moſtrorono di ſoffrir nulla. In tutti queſti caſi eſciva il ſangue ſenſibilmente dalle ferite, onde ſoſ-

pettai,

pettai, che il veleno non poteſſe comunicarſi, ma che foſſe ſpinto addietro, come avevo obſervato del veleno della vipera, che ſpeſſo non nuoce per queſta ragione.

Il mio ſoſpetto venne ben preſto confermato dalle ulteriori eſperienze. Inzuppai un filo ſemplice di veleno, e con eſſo trapaſſai la pelle d'un porchetto d'India in vicinanza di una poppa, non ſoffrì malattia alcuna. Inzuppai un nuovo filo a tre doppi, e lo laſciai prima aſciugare un poco, temendo che il veleno reſtaſſe addietro ſulla pelle nel paſſare il filo per eſſa. Lo feci paſſare attraverſo la pelle d'una coſcia d'un piccolo cuniglio in vicinanza della pancia. Il cuniglio dopo 6 minuti cominciò a tremare, e a moſtrarſi debole. Dopo un altro minuto cadde ſenza poterſi piu muovere. Di quando in quando dava delle piccole convulſioni. Morì dopo altri ſei minuti.

Queſta medeſima eſperienza a fili doppi inzuppati fu da me ripetuta in altri due cunigli, e in trè porchetti d'India, e tutti morirono dentro 30 minuti, e caddero ſenza forza, e convulſi dopo 6, in 7 minuti.

Ero curioſo di vedere ſe il veleno Americano poteva comunicarſi agli animali, e uccidere, applicato ſemplicemente alla pelle grattata, o appena ferita colla punta d'una lancetta. Avevo oſſervato a Parigi, che il veleno della vipera comunica benſì una malattia locale in quei caſi, e che altera, e corrompe la pelle, ma che non arriva

ad

ad uccidere. Il veleno Americano per l'oppoſto non produce mai alcuna malattia locale, come avevo oſſervato, nel far l'eſperienze riportate di ſopra, e laſcia le parti ferite nello ſtato naturale; il che forma una differenza eſſenziale fra il veleno della vipera, e il veleno Americano.

Levai il pelo colle ceſoje ad un piccolo porchetto d'India ſopra la pelle d'una coſcia, e lo graffiai leggiermente con una Lima. Non eſciva ſangue viſibilmente, ma ſi vedevano delle macchiette roſſe, e la pelle inumidita. Bagnai la pelle con una gocciola di veleno ſciolto nell' acqua. Dopo 10 minuti dette dei ſegni di aver le convulſioni, poco dopo cadde, ſenza piu muoverſi, e ſolo di quando in quando aveva delle convulſioni piu e meno grandi. Mori dopo 20 minuti, La pelle dove ſi era applicato il veleno non era punto alterata. Queſta eſperienza ebbe il medeſimo eſito ſopra due altri porchetti d'India, e ſopra un piccolo cuniglio, che morirono tutti tre in meno di 27 minuti coi ſegni piu manifeſti di convulſioni. Volli vedere ſe gli animali piu grandi potevano reggere a queſto veleno applicato ſolo alla pelle graffiata. Colla punta d'una lancetta ferii leggiermente in molti luoghi la pelle prima ſcoperta dei peli, di un gran cuniglio, e la bagnai con piu gocciole di veleno. Dopo 15 minuti diventò meno vivace di prima,

e crollava

e crollava il capo di quando in quando, quasi che non lo potesse sostenere, che con difficoltà, ma in meno di altro 20 minuti ritornò così vivace, che prima. Ripetei l'esperienza sopra un altro cuniglio, ma piu piccolo. Dopo 10 minuti dava de crolli col capo, appena poteva caminare, e reggersi sulle zampe, ma dopo altri 20 minuti ritornò così vivace, che prima.

Rasai circa un pollice di pelle con un rasojo ad un coniglio assai grande. Escì un poco di sangue, benchè non si vedessero i tagli. Messi sopra la pelle circa 3 goccie di veleno. Dopo 6 minuti il cuniglio dette segni di star male, e di esser molto debole. Un minuto dopo cadde, come se fosse stato morto: appena respirava sensibilmente; di quando in quando aveva delle convulsioni. In meno di 46 minuti si riebbe a segno che caminava molto bene, e cominciò poco dopo a mangiare, senza aver piu segno di male veruno.

Graffiai la pelle d'una coscia ad una gallina, e vi applicai il veleno. Non soffrì nulla, benchè ripetessi l'esperienza due altre volte in altre parti della pelle.

Scarificai leggiermente la pelle d'una coscia ad un Piccione, e vi applicai il veleno sciolto nell' acqua. Dopo 25 minuti era si debole, che non si reggeva piu in piede, ed aveva delle convulsioni per intervalli. Cadde poco dopo, come se fosse stato morto, e stette in questo stato di morte appa-

apparente per piu di trè ore. Poco a poco però cominciò a rimettersi, a segno, che dopo mezza ora pareva che non avesse avuto mai nulla.

Quest' esperienza sopra i Piccioni fu replicata cinque altre volte. Tre morirono in meno di 20 minuti, e gli altri due caddero in convulsione, ma si riebbero alla fine.

Da altre esperienze fatte dopo, tanto sopra i volatili, che sopra i quadrupedi ho potuto concludere, che il veleno Americano applicato sopra la pelle appena graffiata un poco può dar la morte, benchè non sempre, nè in tutte le circostanze. Gli animali piu grandi resistono piu facilmente all' azione di quel veleno; quando poi gli animali anche piu deboli non muojono, si trovano dopo poco tempo così bene che prima.

Desideravo di sapere, che quantità di veleno si richiedava, per uccidere un' animale. Una simile ricerca io avevo fatto in Francia sul veleno della vipera, dove avevo determinato la quantità di quel veleno, che si richiedeva per ammazzare i diversi animali. Potevo ben presumere, che pochissimo veleno Americano bastasse per uccidere un piccolo animale, giacchè una, o due gocciole applicate alla pelle graffiata aveva potuto togliere la vita a piu d'uno. Ma volevo qualche cosa di precisо.

Toccai un fiocchetto appena visibile di Cotone, con circa $\frac{1}{50}^{mo}$ d'una gocciola di veleno sciolto nell' acqua, il quale poteva essere appena la $\frac{1}{50}^{ma}$ parte di tutta la gocciola. Introdussi in un muscolo della coscia d'un Piccione il fiocchetto di Cotone, e l'animale non mostrò di soffrir nulla.

Due ore dopo messi in un' altro muscolo un atomo di veleno secco, che appena vedevo cogli occhi, nè il Piccione soffrì per questo. Replicai l'esperienza del veleno secco in tre altri Piccioni, in un de' quali il pezzetto di veleno secco era molto sensibile, ma nessuno morì, o mostrò di soffrire. Feci la stessa esperienza sopra tre porchetti d'India, e sopra due piccoli cunigli col medesimo successo, e nessuno mostrò neanco di soffrire. Il veleno per altro non era stato sciolto dagli umori della parte ferita, e trovai i pezzetti di esso veleno affato intieri.

Applicai sopra un muscolo d'un altro Piccione un fiocchetto di cotone molto maggiore che quei di sopra, e vi applicai circa 8 volte piu di veleno. Il Piccione cadde dopo 6 minuti, e poco dopo morì. Applicai ai muscoli di due porchetti d'India dei fiochetti di cotone imbevuti di veleno appresso a poco come sopra. L'uno morì dopo 12 minuti, l'altro cadde come morto dopo 6, ma si riebbe poco dopo.

Da queſte eſperienze ne concludo, che ſi richieda circa $\frac{1}{100}$ di grano di veleno per uccidere un piccolo animale, e che è neceſſario, che il veleno ſi ſciolga per dar la morte, o per cagionare qualche diſordine nell' economia animale.

Varie eſperienze ho fatto per determinare ſe il veleno Americano applicato alle creſte ferite delle galline, o alle orecchie graffiate dei quadrupedi; era micidiale o pericoloſo. Il veleno della vipera non è ordinariamente micidiale in quelle parti, e la malattia non ſi manifeſta nella creſta avvelenata, ma bensì nelle barbe, che gonfiano orribilmente, e a ſegno di fare ſpeſſo morir l'animale.

Ho adunque ferite piu volte la creſta delle Galline, vi ho applicato il veleno Americano, ve l'ho inſinuato due volte col cotone bene inzuppato di eſſo veleno, ſenza aver mai potuto produrre alcuna malattia. Ma rieſci l'eſperimento meglio nelle orecchie. Dopo di aver fatti piu tentativi tutti infruttuoſi per communicare il veleno graffiando, o feriendo le orecchie di piu cunigli, che non moſtrarono di ſoffrir nulla; alla fine mi rieſci di farne morir due in meno di 30 minuti, dopo di aver loro applicato una gran quantità di veleno nelle parti piu carnoſe delle orecchie, che avevo ferite in moltiſſimi luoghi colla punta della lancetta.

Le eſperienze delle orecchie mi avevano fatto vedere, che dove vi ſono pochi vaſi ſanguigni, o non ſi comunica

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la malattia, o non è mortale. In queſto il veleno Americano ha molta analogia con quello della vipera. Come il veleno della vipera è innocente affatto meſſo ſopra i tendini e ligamenti, ſpecialmente ſe privati di vaſi roſſi; così il veleno Americano meſſo ſopra quelle parti è egualmente innocente. E ſuperfluo che io porti il dettaglio di queſte eſperienze, che non potrebbe eſſere che troppo lungo, e non affatto neceſſario, come ſi vedrà dopo.

Ero deſideroſo di ſapere, ſe il veleno Americano inſinuato ne muſcoli era piu micidiale, che applicato alla pelle, anche traforata da banda a banda. Un groſſo porco d'India, che aveva ſofferto due giorni avanti per due volte l'operazione nella pelle tagliata, ſenza ſoffrir alcuna malattià, ed una terza volta con piccoli ſegni di malattià, morì in meno di 12 minuti dopo di avergli meſſo del veleno ſulle fibre tagliate d'un muſcolo della coſcia. Dopo tre minuti cadde quaſi ſenza ſegni di vita, e con perdita totale di moto. Queſta eſperienza l'ho fatta dieci altre volte, e tutti gli animali ſono morti, tanto i porchi d'India, che i Piccioni, e cunigli di mediocre grandezza; talchè non poſſo dubitar che le ferite avvelenate nei muſcoli non ſieno piu micidiali di quelle fatte nella cute, nelle orecchie, e nelle creſte delle Galline. Il metodo piu certo però di rieſcire ſi è di inzuppare bene nel veleno un pezzetto di legno ſpugnioſo, e tagliente, è di inſinuarlo coſi

quasi seccato nella sostanza del muscolo scoperto. Ma questo metodo non riescì per altro per tre volte, che ne feci uso sopra le creste delle Galline. Non potei vedere nessun segno di malattià, benchè il legno fosse bene inzuppato, e lo lasciassi per piu ore nelle creste traforate.

In questa occasione feci uso delle freccie: molte ne adoprai traforando la pelle degli animali, e molte altre traforando i muscoli. Non tutti gli animali, specialmente fra i groffi cunigli, benche feriti con esse nella pelle morirono, sebben peraltro ne morisse la piu gran parte; ma nessuno ne guarì fra quelli a cui avevo traforato con esse i muscoli. In generale ho trovato, che le freccie sono piu pericolose, e piu micidiali, che il veleno sciolto nell' acqua, quando è semplicemente applicato alle parti ferite. Ho trovato, che è piu attivo il veleno delle freccie se si bagniano prima nell' acqua calda, e che allora operano piu sicuramente, e piu prontamente, e cresce ancor di piu la loro attività, se si inzuppano prima nel veleno bollito nell' acqua a consistenza di giulebbe. Vari animali anche grandi come i cunigli sono caduti senza potersi piu muovere in meno di due minuti; qualcheduno de piccoli ha mostrato di soffrire in meno di un minuto.

Insinuai una freccia ben inzuppata prima nel veleno bollito nella cresta d'una gallina, e ve la lasciai un giorno

intiero, senza che l'animale avesse dato segno di soffrir nulla. Il giorno dopo le traforai la cresta, e le barbe con due freccie preparate, come sopra, e ve le lasciai per 10 ore. La gallina non soffrì nulla ne anco in questa seconda esperienza. Allora gli insinuai una freccia attraverso un muscolo delle coscie, e morì in 42 minuti.

Fra le richerche, che mi ero proposto nell' esame di questo veleno, ve ne era una sopra le alterazioni, che poteva soffrire unendolo agli acidi, e agli alcalini, come avevo fatto del veleno della vipera. Avevo trovato, che nè gli acidi minerali piu potenti, nè gli alcalini piu attivi toglievano le qualità mal facienti al veleno della vipera. Per questo fine sciolsi nei tre acidi minerali il veleno, e ne sciolsi ancora nell' aceto di stillato, e nel rum, e dopo qualche ora feci le seguenti esperienze.

Feci dei piccoli tagli sopra la pelle d'un piccolo porco d'India, e la coprii piu volte di veleno sciolto nell' acido nitroso. L'animale non parve di soffrir nulla, che l'incomodo meccanico della ferita, e dell' acido. Dopo un ora era tanto vivace, che prima. Dopo due ore ripetei l'esperienza in un altra parte della pella preparata come sopra, che coprii di veleno sciolto nel Rum, e l'animale morì in meno di 4 minuti.

Ferii leggiermente la pelle d'un piccolo cuniglio, e vi applicai sopra piu goccie di veleno sciolto nell' olio di vetriolo.

vetriolo. Non mostrò di soffrir nulla, ed era così vivace che prima. Dopo 4 ore preparai un altra parte della pelle come sopra, e vi applicai poche goccie di velena sciolto nell' aceto distillato. Morì in 6 secondi, e cascò in meno di quattro.

Preparai la pelle al solito d'un altro piccolo cuniglio, e la coperfi con veleno sciolto nell' acido marino. L'animale non parve che soffrisse nulla, dopo 6 ore applicai il veleno sciolto nel Rum ad un altra parte della pelle. Dopo 45 minuti cadde con convulsioni, ma si ristabili in meno d'un ora.

Da queste prime esperienze parrebbe, che gli acidi minerali rendessero innocente questo veleno, e che per lo contrario l'aceto, e il Rum non vi facessero alcuna alterazione. Continuai le mie esperienze sopra il veleno sciolto nell' aceto, e nel Rum, e i resultati furono un poco vari. Di sei animali trattati col veleno sciolto nell' aceto, due soli morirono, due ebbero tutti i segni della malattia di veleno, e due altri non ebber nulla. Di sei altri trattati col veleno sciolto nel Rum ne morirono cinque, e il sesto ebbe la malattia del veleno; onde par dimostrato, che il veleno sciolto in que' due fluidi conserva le sue qualita micidiali.

Per l'opposto ho ripetute le esperienze del veleno sciolto negli acidi minerali sopra sei animali, e nessuno è morto,

morto, o ha moſtrato di aver neſſun principio di malattia di veleno. Mi venne il ſoſpetto, che forſe il veleno non uccideſſe non perchè aveſſe perdute le ſue qualità micidiali, ma piuttoſto perchè non poteva inſinuarſi nelle parti ferite a motivo della troppo grande azione degli acidi minerali ſopra la pelle, e ſopra i vaſi, che raggrinzano e brucciano in qualche maniera. Per riſchiarirmi di queſto dubbio feci evaporare al fuoco il veleno ſciolto negli acidi minerali, e fatto ſecco lo applicai piu volte a piu animali in diverſe parti della loro pelle. Ma neſſuno dette ſegno di ſoffrire.

Pare adunque, che gli acidi minerali tolgano le qualità nocive al veleno Americano: diſſi ſemplicemente, che pare, perchè ſi potrebbe forſe ſoſpettare, che rimanendo un poco di acido unito al veleno dopo evaporato, ſi produceſſe la ſolita alterazione ne vaſi della pelle. Avrei dovuto ripeter qualche altra eſperienza dopo di averlo piu volte lavato in acqua, e reſo inſipido, ma in quel tempo mi ſono mancati gli animali per verificar queſto nuovo ſoſpetto, e dopo non ho piu avuto tempo di ritornare ſopra queſta materia.

Intorno ai ſali alcalini poſſo dire, che non ſono accorto, che aveſſero alterato quel veleno per neſſun conto, e reſo meno micidiale di prima; e bensì vero, che queſte eſperienze non le ho tanto ripetute, ne ſi variate, come ſi dovrebbe,

dovrebbe, e come avrei ancora fatto, ſo non aveſſi trovata gran difficoltà in procurar gli animali, e non aveſſi avuto in viſta della eſperienze piu importanti affai.

Era naturale che io ſoſpetaſſi, che ſiccome gli acidi impediſcono l'azione del veleno contro gli animali, poteſſero ancora eſſere un rimedio contro quel veleno.

Preparai al ſolito la pelle d'un porchetto d'India, e la coperſi tutta con veleno, e circa 40 ſecondi dopo la lavai con acido nitroſo, e poi con acqua pura. L'animale non ſoffrì nulla. Dopo due ore lo avvelenai in un muſcolo, e vi applicai ſubito l'acido nitroſo, ma cadde nel momento convulſo e ſenza forza, ed era morto dopo 2 minuti.

Ripetei queſt' eſperienza nei muſcoli d'un altro porchetto d'India, ed appena avvelenato, gli lavai con acido nitroſo, e un poco d'acqua. Dopo due minuti cadde convulſo, ed era morto dopo 4.

Avuelenai, come ſopra i muſcoli di 4 piccioni, e nel momento dopo gli lavai con acido nitroſo. Morirono un minuto dopo. Dubitando che foſſe affetto dell' acido nitroſo piuttoſo che del veleno, feci uſo di acido nitroſo molto indebolito ſopra 4 altri piccioni, ma morirono tutti 4, benche affai piu tardi. Volli vedere, ſe la ſemplice applicazione dell' acido nitroſo ai muſcoli poteva uccidere i piccioni, e i piccoli porchetti d'India, lo ſperimentai ſopra due

due piccioni, e sopra due porchi d'India. I piccioni morirono tutti due poco dopo, ma non già i porchetti d'India, benchè uno mostrasse di aver molto sofferto.

Mi pare adunque, che gli acidi sieno un rimedio inutile, o pericoloso applicato ai muscoli avvelenati dell' animale.

Nulla dirò di qualche altro rimedio, che ho adoprato, perchè ho trovato coll' esperienza, che tutto è inutile, o si applichino presto, o tardi, o esternamente, o internamente. Quando il veleno è insinuato profondamente, quando si è già introdotto negli umori, qualunque rimedio è gia tardo, ed inutile.

Mi restava bensì da fare una ricerca assai piccante, e che avrebbe potuto ancora in qualche caso essere utile. Le mie esperienze sopra il veleno della vipera mi hanno data occasione di far la medesima ricerca sopra il veleno Americano. Avevo determinato con esse il tempo che impiega il veleno della vipera per diffondersi nel corpo dell' animale; e quando poteva esser utile di recider la parte avvelenata, o di far delle legature per impedire, che il veleno si comunichi col mezzo del sangue all' animale.

Introdussi ne' muscoli d'una gamba d'un piccione una freccia Americana bagniata prima nell' acqua calda. Dopo quattro minuti feci una legatura mediocremente forte al di sopra della parte ferita, subito sopra del

e vi laſciai la freccia. Dopo 26 ore l'animale non parve che aveſſe altra malattia che della ſemplice legatura. Allora levai la freccia, e ſciolſi la legatura. La parte era un poco gonfia, e livida; ma l'animale non morì per queſto, benchè non poteſſe far uſo della gamba, che dopo molti giorni, e con qualche ſtento.

Paſſai con una nuova freccia i muſcoli d'un altro piccione, come ſopra, e dopo ſei minuti vi feci la legatura, e vi laſciai la freccia. Dopo altri quattro minuti il piccione non aveva piu forza per ſoſtenerſi, o tener ritto il capo. Poco dopo cadde come ſe foſſe morto, e morì infatti dopo altri ſei minuti.

Ripetei la medeſima eſperienza ſopra d'un altro piccione, e laſciai nei muſcoli la freccia. Dopo 8 minuti legai la gamba, dopo 3 altri minuti cominciò a dar ſegni di ſtar male, ma poco dopo ſi riebbe. Dopo 26 ore viveva ancora, benchè i muſcoli foſſero lividi. Levai la legatura, e dopo due ore morì.

Sottopoſi un piccione alle iſteſſe eſperienze, e feci l'allaciatura dopo 5 minuti, laſciando la freccia nè muſcoli. Morì dopo due ore.

Feci le ſteſſe eſperienze ſopra altri quattro piccioni, ai quali feci la legatura dopo due minuti. Neſſuno morì di eſſi; dopo 10 ore levai le legature, e ne morirono tre; il quarto guarì perfettamente.

Ripetei

Ripetei ſopra altri quattro piccioni le medeſime eſperienze nelle ſteſſe circonſtanze, e levai le legature dopo 30 ore. Ne morì un ſolo, e morì dopo due giorni, certamente per effetto della legatura troppo forte, che aveva prodotta la gangrena né muſcoli. Queſte ſteſſe eſperienze ſono ſtate da me ripetute ſopra piccioni molto più giovani, ai quali ſi può tagliare ſenza che muojono, la gamba ſotto il femore. Non ne morì neſſuno di quelle ai quali avevo tagliata la gamba dopo due minuti, e due di dieci morirono, ai quali avevo tagliata la gamba dopo 3 minuti.

Con queſto metodo muojono meno piccioni, che colle legature, quando ſi fa uſo di eſſe nello ſteſſo tempo. La ragione è, che il taglio non produce morte, né alcuno ſconcerto notabile in queſti animali, laddove la legatura fa ſpeſſo ingangrenire le parte ferite dalle freccie, e il piccione muore ſpeſſo della gangrena. Le medeſime eſperienze ho fatte ſopra i piccioli porchi d'India, e i più piccoli cunigli, quando tagliando le gambe, quando facendo le legature. I riſultati ſono ſtati in parte analoghi a quelli oſſervati nei Piccioni, benchè un poco meno coſtanti, e più incerti.

In generale ho veduto, che ſi richiede un dato tempo, perché il veleno Americano ſi comunichi all' animale, che queſto tempo è molto più grande che quello che ſi richiede, perchè ſi comunichi il veleno della vipera, e

che gli effetti ſopra gli animali ſono piu vaghi, e piu variati nel veleno Americano, e che finalmente ſi può guarire dall' un veleno, e dall' altro col recider le parti, quando ſi poſſon recidere ſenza riſchio della morte, e ſi faccia il taglio in tempo.

Nelle mie eſperienze fatte ſopra il veleno della vipera ho trovato che non è poi veleno per tutti gli animali, e che vi ſono degli animali a ſangue freddo, per i quali è affatto innocente. Ero curioſo di vedere ſe ſeguiva l'iſteſſo del veleno Americano. Tutti i ſcrittori del veleno Americano ci dicono, che è veleno per tutti gli animali, ma il credere una coſa è ben lontano dal provarla. Ci vogliono delle eſperienze, ce ne voglion moltiſſime, e non ſi vede che ne abbiano fatte abbaſtanza per cavare una illazione ſi generale.

Cominciai dall' inſinuarlo nei muſcoli delle rane, le quali morirono in poco tempo. Paſſai alle anguille, nelle quali inſinuavo delle freccie verſo la coda, e morirono tutte benchè molto tardi.

Avevo trovato il veleno della vipera affatto innocente per la vipera medeſima, e per quei ſerpenti, che in Toſcana ſi chiamano binchi, e dai franceſi ſono chiamati couleuvres. Di queſti ultime non ne potei avere che due ſoli, onde non feci che poche eſperienze, benche io le creda deciſive affatto. Ne ferii uno con una freccia bene im-

brattata di veleno a consistenza di sciroppo, verso la coda, e vi lasciai la freccia nei muscoli. Nel luogo per dove insinuai la freccia avevo prima fatto una incisione, perchè potesse entrare facilmente nei muscoli anche il veleno sciolto, che era sopra la freccia. Nel luogo poi della ferita v'insinuai del nuovo veleno facendo de' piccoli tagli nei muscoli. Il serpente non mostrò di soffrir nulla, e dopo più ore era così bene che prima. Lo serrai dentro di una cassa, la quale avendo aperto dopo altre sei ore trovai, che il serpe era fuggito, nè potei più ritrovarlo dopo. In un altro, un poco minore, ripetei l'esperienza più volte a diversi intervalli. L'ultima volta insinuai due freccie avvelenate nei muscoli della coda, e ve le lasciai per 24 ore. Intorno alle ferite vi applicai più volte il veleno a consistenza de sciroppo, e ve lo introdussi a gran dosi con uno stecco. L'animale non morì, e non parve che soffrisse sensibilmente.

Questa stessa esperienza ho potuto però farla più volte sopra le vipere, nessuna è morta per il veleno, benchè qualcuna fosse ferita nei muscoli verso la coda di più freccie, e bene spalmata di veleno a consistenza di sciroppo. Lasciavo le freccie per 20, e 30 ore nei muscoli, nè per questo ne morì mai alcuna. E bensì vero, che alcune poco dopo avvelenate parevano meno vivaci di prima, e pareva, che la parte ferita, o la metà posteriore

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del corpo aveſſe perduto ſenſibilmente del ſuo moto naturale, e queſto torpore durò in alcune per molte ore, altre poi erano ſempre tanto vivaci, che prima.

Non dubito dopo tutto queſto di aſſerire, che il veleno Americano è affatto innocente per queſti animali a ſangue freddo, come lo è il veleno della vipera; nella qual coſa queſti due veleni hanno una analogia molto grande: benchè l'uno non ſia che una gomma animale, come ho dimoſtrato altrove, e l'altro un ſemplice ſucco vegetabile.

Mi rimaneva di eſſaminare l'azione di queſto veleno ſopra gli animali viventi; o ſia, quali ſieno le parti alterate dal veleno Americano nell' animale, per cui ne ſegue la morte.

Tutto concorreva a far credere, che eccitaſſe una di quelle malattie, che dai medici moderni ſon chiamate nervoſe. I ſintomi della malattià ſoni i piu preciſi, e i piu deciſi per quel genere di malattie. Convulſioni, debolezze, perdita totale di forze, e di moto, ſentimento diminuito, o quaſi tolto affatto; ſono i ſintomi piu comuni di quel veleno negli animali. Speſſo ſi oſſerva, che l'animale da vivace, che era un momento prima, ſi trova un momento dopo ſenza moto, e ſenza ſenſo, e proſſimo alla morte. Ho oſſervato in generale un ſintoma che pare una vera dimoſtrazione, che la mallatià prodotta da queſto veleno ſia parimente nervoſa. Se l'animale non muore

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in pochi minuti, si trova tanto bene che prima, e non pare che habbia sofferto nulla, benchè sia rimasto in uno stato di letargo tal volta per piu ore, senza segni certi, e manifesti di vita. Questo è appunto il caso di quelle malattie che si chiamano nervose: vengon spesso ad un tratto, risvegliano quando de' moti, e quando privano affatto di forze, ma appena cominciano a dissiparsi gli effetti della malattia, che la persona si trova benissimo, e appena si accorge d'aver sofferto qualche male. Ma tutti questi segni non potranno piu impormi dopo le mie esperienze sopra il veleno della vipera: anche la malattia prodotta da quel veleno ha dei sintomi delle malattie nervose, e pare, che i nervi sieno affetti principalmente, benchè l'esperienza abbia deciso il contrario. Bisogniava dunque anche qui ricorrere all' esperienza, e non si lasciar sedurre da teorie male imaginate, e da ragioni apparenti.

Per procedere con metodo in una questione cosi importante, ho creduto bene di cominciare dall' esaminare se il veleno Americano produce qualche alterazione sensibile sopra il sangue degli animali cavato dei vasi, e mescolato con esso.

Ho reciso il capo ad un piccione, ed ho ricevuto in due bicchieri tepidi, e conici, il sangue ancor caldo d'un piccione. In ciascuno dei bicchieri ne feci cadere circa 80 gocciole. In uno de bicchieri messi quattro gocciole di

acqua, nell' altro quattro gocciole di veleno sciolto parimente nell' acqua. La quantità del veleno delle quattro gocciole, appena arrivava ad un grano in peso, quando era secco. Nel medesimo istante girai i due bicchieri per pochi secondi egualmente, e in modo che le materie si mescolassero. Dopo 2 minuti il sangue mescolato coll' acqua, si era coagolato. L'altro sangue unito al veleno Americano non si coagolò mai, ma era in vece piu oscuro, e piu nero dell' altro, che era rossèggiante al solito. Dopo 3 ore era ancor fluido come prima, quando nell' altro bicchiere si vedeva, che il siero si era già separati dalla parte rossa.

Esaminai col microscopio allora, e dopo, il sangue de due bicchieri, e trovai che nell' uno, e nell' altro i globetti rossi conservavano la loro prima figura, e che non differivano punto fra di loro.

Questo esperimento ripetuto piu volte ha sempre avuto il medesimo successo, talchè par cosa evidente, che il veleno Americano non altera sensibilmente i globetti rossi del sangue nelle circostanze accennate. Non lascia però di esser degno d'attenzione, che questo veleno è si lontano dal coagulare il sangue, che anzi impedisce assolutamente che egli si coagoli, come segue quando il sangue è cavato dai vasi; nè si può dire che egli attenui, o disciolga il sangue, perchè nulla di questo si osserva, quando si esamina

esamina al microscopio. La parte rossa è figurata come nello stato naturale, e nulla si osserva di piu sottile, e di piu fluido in quell' umore.

Una cosa affatto simile abbiamo osservato ancora succedere col veleno della vipera, tal chè gli effetti, o alterazioni fatte da queste due veleni sul sangue cavato dai vasi pajono affatto simili; l'uno e l'altro veleno impediscono, che il sangue si coagoli, e nè l'uno ne' l'altro scioglie, o altera i globetti del sangue, e la sola differenza fra essi consiste, che il veleno della vipera tinge assai piu in nero il sangue, che il veleno Americano.

Il veleno della vipera non altera i globetti, nè anco quando si comunica all' animale vivente, e che ne segue la morte dell' animale medesimo. L'istesso ho osservato nell' sangue di quelli animali, che sono morti dal veleno Americano, talchè i due veleni convengono mirabilmente in tutti questi casi. Ma si è veduto, che il veleno della vipera produce una alterazione sensibile sopra la massa del sangue in generale negli animali morsicati; la stessa attenzione ho creduto di dover portare nell' esame del sangue degli animali morti per il veleno Americano.

In generale mi è parso, che i muscoli degli animali morti dal veleno Americano fossero piu pallidi di prima. I vasi venosi verso il cuore mi sono parsi piu turgidi del solito. Il sangue un poco piu oscuro dell' ordinario, ma

non moltiſſimo, e non coagulato. I viſceri del baſſo ventre non ſenſibilmente alterati, il cuore, e le orecchiette in ſtato naturale, il cuore però par che abbia qualche volta i ſuoi vaſi eſterni piu viſibili, e quaſi injettati.

Ma ho oſſervato però una grande alterazione in un viſcere dei piu eſſenziali alla vita. Il polmone è mi parſo ſempre molto alterato. L'ho trovato generalmente macchiato piu, e meno, e ſpeſſo di macchie aſſai larghe, e livide. In alcuni ſi ſarebbe creduto, che foſſe tutto putrefatto. Queſta alterazione in un viſcere ſi eſſenziale alla vita merita la piu grande attenzione, e mi è parſo, che ſia tanto piu grande, quanto più l'animale è viſſuto, dopo di eſſere ſtato avvelenato. Ho oſſervato il polmone di alcuni animali eſſer qua e là traſparente, ſpecialmente verſo i lembi. Si vedeva beniſſimo l'aria polmonare attraverſo della membrana eſterna. L'ho eſaminato col microſcopio, ed ho oſſervato beniſſimo le piccoli veſcichette polmonare irrigate di vaſi per la piu gran parte privati di ſangue.

Per quanto foſſe grande queſta alterazione in un viſcere tanto importante non ſapevo affatto perſuadermi, che ſola poteſſe produrre una malattià coſi grande, e coſi momentanea, e che tutta l'azione del veleno foſſe ſolamente contro il ſangue, e contro il polmone. E vero, che

avevo

avevo l'esempio del veleno della vipera, che produce qualche cosa di simile, ma questo veleno produce un coagulo quasi generale del sangue medesimo, che non si osserva certamente nel veleno Americano.

In una ricerca così importante, e si oscura nel tempo stesso, ho creduto di dover ricorrere all' esperienza medesima, e di esaminare gli effetti del veleno Americano introdotto immediatamente nel sangue. Mi son servito dei medesimi mezzi che ho adoperati per introdurre nel sangue della jugulare il veleno delle vipere. Un sifoncino di vetro ricurvo in punta faceva le veci d'una piccola siringa. Con questo sifoncino assorbivo il veleno Americano sciolto prima nell' acqua, e aperta la vena jugulare lo spingevo dentro di essa. Siccome il metodo di far questa sorta di esperienze è di già descritto nelle mia opera sul veleno della vipera, ho creduto di non dover qui darne a parte una descrizione. L'esperienza è talmente condotta, che il veleno entra per la jugulare nel sangue, senza toccare a nessuna parte tagliata del vaso, neanco della jugulare medesima.

Quattro gocciole di veleno sciolto nell' acqua io messi nella siringa di vetro per la prima esperienza. La quantità del veleno nelle quattro gocciole appena poteva montare ad un mezzo grano. Introdotto il becco ricurvo della siringa nella jugulare d'un grossissimo cuniglio,

nell' atto di spingere lo stantuffo, m'accorsi che il veleno era ritornato indietro, a motivo che lo stantuffo non s'accostava bene alle pareti della siringa, onde dissi alle persone, che erano presenti, che l'esperienza era mancata. Ma restai sorpreso quando sentii dirmi, che l'animale era già morto. Io non credo, che vi corressero dieci secondi dal momento in cui viddi il veleno ritornare indietro, al sentir dire che l'animale era già morto, e lo era in fatti. Jo non posso dire, che quantità di veleno sia stata introdotta nel sangue, se l'animale è morte bisogna pure che ne sia stata introdotta una quantità sufficiente; senza di questo io avrei giudicato dalla quantità del veleno ritornato addietro, che neppure un atomo ne fosse entrato nella jugulare.

L'animale era talmente morto, che non appariva alcun segno o moto di respirazione, e tutto il corpo era così cascante e rilasciato in tutte le parti, che non si trova negli animali neanco morti da lungo tempo. La morte di questo animale è stata così vicina all' introduzione del veleno che non è parso che vi corresse nessun tempo sensibile: mi é parsa molto piu pronta, che ne' casi del veleno della vipera introdotto nel sangue nell stesse circostanze.

Rimessa la mia siringa in migliore stato v'introdussi due gocciole sole di acqua a cui avevo prima unito $\frac{1}{4}$ di gocciola del veleno di sopra sciolto nell' acqua. Appena

incominciai a ſpingere il veleno per la jugulare, che veddi il cuniglio cader morto, come ſe foſſe ſtato toccato dal fulmine. Jo non credo che foſſe introdotto nel ſangue mezza gocciola del liquor della ſciringa, quando l'animale cadde ſenza moto, e ſenza vita.

In generale mi par di poter dire da altre eſperienze fatte poi, che queſto veleno introdotto immediatamente nel ſangue per la jugulare uccide piu preſto, e in minor quantità del veleno della vipera. La morte ſegue coſi da vicino l'introduzione del veleno nel ſangue, che previene ordinariamente le convulſioni dell' animale. Se ſi prende una minor quantità di quel veleno allora ſi oſſervano le ſolite convulſioni, e battimenti, e la morte non ſegue coſi ſubito.

E vero che il ſangue non è coagulato, ne si alterato nel colore, come quando s'introduce nella jugulare il veleno della vipera; ma non per queſto la morte ſegue piu tardi, e non è men certo, che il veleno Americano introdotto nel ſangue immediatamente, come il veleno della vipera, uccide nella ſteſſa maniera gli animali.

Queſta è une verità di eſperienza, a cui nulla vi é da opporre, comunque poi poſſa eſſere oſcura, o poco s'intenda la cauſa della morte nei caſi di ſopra. Il veleno Americano introdotto nel ſangue uccide l'animale nell' iſtante, onde pare ancora indubitato, che quando ſi ap-

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plica eſteriormente ad una parte ferita d' un animale vivente, poſſa e debba ancora portare per mezzo del ſangue de gravi ſconcerti all' economia animale, e la morte medeſima. La morte dell' animale, che ſeque nel momento, che ſi introduce quel veleno per le jugulari nel ſangue, pare una dimoſtrazione, ſenza replica, che in quei caſi tutta l'azione del veleno è contro il ſangue medeſimo, e che il ſiſtema nervoſo non è punto affetto, o alterato. Ma tutto queſto non è ancora una prova, che i nervi non poſſano eſſere piu e meno affetti da quel veleno, quando la morte ſegue molto piu tardi, e quando ſi applica eſternamente ſulle parti ferite. In queſti caſi vi ſono principalmente le convulſioni, e tutti i ſegni d'una malattià nervoſa. Può adunque beniſſimo il nervo eſſere affetto dal veleno, ed eſſer la principal cagione della morte dell' animale.

Biſognavo per altro anche qui ricorrere all' eſperienza diretta, come ſi è fatto del veleno della vipera, e vedere quali ſconcerti, e malattie produce il veleno Americano applicato immediatamente ſopra i nervi, ſenza toccare ai vaſi.

Le mie eſperienze ſono ſtate fatte ſopra i nervi ſciatici dei piu groſſi cunigli, ed ho preparati quei nervi nella medeſima maniera che ho fatto a Parigi operando ſul veleno della vipera, e per queſto io non darò qui alcun

dettaglio

dettaglio risguardante il metodo di preparar questi nervi. Accennerò ben si un picciol numero di esperienze principali fatte su i nervi, perchè si vegga la varietà, che ho incontrato principalmente nei primi tentativi, i quali avrebbono potuto ingannarmi, se non mi fossi ostinato a moltiplicar le mie esperienze, e a variarle a proporzione, che trovavo dei risultati poco conformi. A questa costanza, o ostinazione, che si voglia chiamare, io devo principalmente le nuove verità, che credo di aver trovate sopra i due veleni della vipera, e del Ticunas.

Isolato il nervo sciatico ad un cuniglio vi passai per disotto un cencio fino a piu doppi, e posi sopra il nervo un fiochetto di fila ben imbrattato di veleno Americano a consistenza di sciroppo. Coprii il nervo con il medesimo cencio, perchè il veleno non scorresse nei muscoli scoperti dell' animale, e cucii al solito la pelle. Dopo 10 minuti il cuniglio cominciò ad aver delle convulsioni, a non piu reggersi in piede, a cader con tutti i segni dell' mallatia di veleno, e morì poco dopo.

Ripetei questa esperienza in un altro cuniglio, e procurai d' inviluppare con dei cenci, anche meglio, il nervo avvelenato, come sopra. Questo secondo cuniglio non mostrò di soffrir nulla per 10 ore di seguito, che l'osservai, ma dopo due altre ore lo trovai morto da poco prima, perchè era ancora caldo.

Soſpettai, che il veleno applicato al nervo, eſſendo in qualche quantità notabile, poteſſe alla lunga penetrare, unitamente agli umori delle parti tagliate, attraverſo i cenci, e portar la ſua azione ſopra i muſcoli, e le parti adiacenti. Biſognava dunque, o ſcemare il veleno, o aumentare i cenci, e impedire qualunque diffuſione di veleno attraverſo di eſſi. Mi attenni a queſto ultimo come piu ſicuro.

Iſolai il nervo ſciatico al ſolito ad un cuniglio, e vi poſi per diſotto un cencio finiſſimo a moltiſſimi doppi. Collocai ſopra il nervo il fiocco de' fili ben inzuppati nel veleno, e coperſi ogni coſa coi lembi del cencio. Queſto cuniglio viſſe 24 ore, e ſolo dette ſegnio di ſtar male nell' ultima ora, ma ſenza, che poteſſi ſoſpettare che moriſſe di malattià di veleno.

Preparai ad un nuovo cuniglio il nervo ſciatico, come ſopra, e lo coprii di veleno, e dei ſoliti cenci. Mori dopo 40 ore, ſenza ſegni di malattia di veleno.

Feci la medeſima eſperienza del nervo ſciatico ſopra altri tre cunigli, avendo tutta l'attenzione, che i nervi avvelenati foſſero ben coperti dei cenci, e non vi foſſe ſoſpetto alcuno, che il veleno ſi poteſſe diffondere attraverſo di eſſi. Uno morì dopo 3 giorni, e gli altri due vivevano ancora dopo 8 giorni.

Preparai

Preparai appunto come sopra i nervi di due altre cunigli, ma senza veleno per fare una esperienza di confronto. Un cuniglio morì dopo 36 ore, e l'altro viveva dopo 8 giorni.

Queste esperienze mi parevano sufficienti, per giudicare se il veleno Americano applicato esternamente ai nervi è capace di produrre qualche sconcerto, o malattià nell' animale, ma mi restava da sapere, se era egualmente inattivo quando si applicava ai nervi feriti, o sia alla polpa medesima dei nervi.

Preparai come sopra il nervo sciatico d'un cuniglio, e prima di applicarvi il veleno lo ferii piu volte con una lancetta da parte a parte. Appunto sopra la parte ferita del nervo applicai il veleno. Il cuniglio visse cinque giorni, e morì senza segni di mallattià. Ripetei l'esperienza sopra un altro cuniglio colle medesime circostanze, il quale viveva ancora dopo 8 giorni.

Variai un poco l'esperimento sopra i nervi di tre altri cunigli. In vece di far colla lancetta molti tagli aprii il nervo longitudinalmente per piu di cinque linee, e insinuai per la fessura i fili ben inzuppati di veleno, e copersi bene ogni cosa. Uno morì dopo 60 ore, senza segni di mallattià di veleno, e gli altri due vivevano dopo 8 giorni.

Credetti di dover variare ancora questa seconda sorta di esperienze, e di farne qualcheduna recidendo il nervo,

come avevo fatto eſaminando il veleno della vipera. Recidevo il nervo ſciatico il piu lontano, che potevo dal capo, perchè io poteſſi facilmente inviluppario coi cenci. La parte iſolata del nervo nei piu groſſi cunigli èra circa un pollice e mezzo. Collocato il nervo ſopra i cenci, lo ſpalmavo bene di veleno nella parte reciſa, e coprivo ogni coſa coi ſoliti cenci.

Queſto eſperimento lo feci ſopra 6 cunigli, due morirono in 40 ore, due dopo 3 giorni, e due vivevano ancora nel quarto giorno.

Per fare una eſperienza di confronto preparai come ſopra i nervi di due cunigli, che reciſi, ma non avvelenai. Uno morì dopo 36 ore, e l'altro viveva nel terzo giorno.

La coſtanza dei riſultati di queſte eſperienze ſopra i nervi mi ha fatto creder ſuperfluo di ripeterne di piu, e ho creduto, che non laſciaſſero alcun dubbio in chi è avvezzo a ſperimentare, e non è prevenuto per ipoteſi mal provate. Quì ſi vede, che il veleno Americano non è veleno applicato comunque ai nervi, e che non produce alcun ſenſibile ſconcerto ſopra l'economia dell' animale vivente in quei caſi. Queſto è quello che depone l'eſperienza immediata. Il ſupporre quello che non ſi vede, il credere quello, che è contraddetto dall' eſperienza è ſognare nelle coſe fiſiche, e correr dietro all' errore per

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la verità, e adottar l'immaginazione per il fatto. Il veleno Americano, ſimile in queſto al veleno della vipera non è veleno per i nervi, ed è un ſucco innocente comunque applicato ad eſſi, come lo è il veleno della vipera. Ma queſto veleno uccide nella piu piccola quantità, e uccide nel momento, ſe ſi introduce immediatamente nel ſangue per la jugulare, come fa il veleno della vipera; la ſua azione è adunque tutta contro il ſangue e non già punto contro i nervi, qualunque poi ſia il principio, o il meccaniſmo per cui ne ſegue la morte.

Gli effetti, e le alterazioni del veleno della vipera ſopra del ſangue ſono piu deciſi, e piu evidenti. Vi è un coagulo, che non ſi puo negare, e che non ſi oſſerva nel ſangue degli animali morti per il veleno Americano. Ma ſi vede però in queſti una grande alterazione nel polmone, e che quel viſcere è nel piu gran diſordine.

E vero che la morte ſuccede ſi ſubito injettando ſpecialmente il veleno Americano per i vaſi, che non ſi può ben comprendere come ſucceda la morte in ſi breve tempo: ſi direbbe, che appena il veleno è arrivato al cuore, che l'animale è già morto; nè ſi intende bene, come poſſano morire gli animali a ſangue freddo, come per eſempio le rane, che vivono ſi lungo tempo a circolazione arreſtata, benchè ſia vero, che muojono molto piu tardi per quei veleni degli altri animali a ſangue

caldo. Un umore, o il ſangue alterato da un veleno può produrre poco a poco negli animali a ſangue freddo dei ſconcerti anche maggiori di quello, che poſſano eſſer prodotti dalla circolazione arreſtata.

La morte, che ſegue immediatamente introdotto il veleno nel ſangue potrebbe far ſoſpettare, che vi è in quell' umore un principio piu attivo, piu ſottile, e piu volatile, che sfugge la viſta piu acuta ed il microſcopio medeſimo. Queſto principio parebbe in queſta ipoteſi neceſſario alla vita, e ſopra di queſto principio ſi crederebbe che il veleno portaſſe principalmente la ſua azione.

Che veramente eſiſta nèl ſangue un principio piu attivo e piu volatile, par che ſi poſſa ſoſpettare dal veder che il veleno della vipera impediſce il coagolo del ſangue cavato dai vaſi, e che per contrario lo produce dentro de vaſi medeſimi. Nel primo caſo ſi crederebbe, che è evaporata dal ſangue qualche coſa, che eſiſte nel ſangue dentro de' vaſi. In queſta ipoteſi queſto principio attivo, e di vita potrebbe conſiderarſi come il riſultato di tutta l'economia animale, nè i nervi anderebbono eſcluſi, che anzi potrebbono concorrervi il piu. Ma tutto queſto non è che ſemplice congettura piu, o meno probabile, e che l'eſperienza non dimoſtra. Biſogna tenerci ai fatti certi, qualunque poi ſia la maniera di ſpiegarli. Queſti fatti

ſono, che il veleno Americano non agiſce punto contro i nervi, e che agiſce intieramente contro del ſangue.

Neſſuno avrebbe dubitato prima delle mie eſperienze, che l'azione del veleno Americano non foſſe immediatamente contro de' nervi. Tutti i ſegni eſterni la dichiavano tale. Queſti ſegni ſono adunque equivoci, e a torto ſi prendono dai medici per prova ſicura, che la malattià ſia puramente nervoſa. Vi poſſono eſſere tutti queſti ſegni ſenza che i nervi ſieno punto affetti: il ſolo ſangue alterato baſta per farli naſcere nel momento. I piu gran medici hanno attribuito ad alterazione nervoſa la malattià prodotta dal veleno della vipera, e dal veleno Americano; tocca ora ad eſſi medeſimi di eſaminare, ſe altre malattie, che ſi ſono attribuite ai nervi non ſono piuttoſto malattie dei fluidi, malattie del ſangue. Il ſoſpetto è grande, i ſegni equivoci, il principio non dimoſtrato nella ſua generalità. Io non voglio già negare, che neſſuna malattià poſſa mai derivare dai nervi; queſto farebbe dare in un eſtremo, per evitarne un altro. E indubitato, che molte malattie ſono nervoſe nella loro origine, e che molte altre lo ſono per alterazione ſeguita in altre parti, anche ſemplicemente fluide; le paſſioni dell' animo ci fanno vedere quel che poſſano i nervi ſopra le parti del corpo vivente. Ma tutto queſto non prova già, che tutte le malattie attribuite ai nervi ſieno nervoſe, e che i ſegni ordi-

nari

nari di quelle malattie non ſieno equivoci. Ed è poi certo che i veleni da noi eſaminati non hanno alcuna azione immediata contro i nervi, come ſi è creduto comunemente fin qui. Si vorrà da tal uno objettare, che forſe il veleno della vipera, e il veleno Americano non agiſcono che ſulle ultime extremità nervoſe, e che per queſto ſono innocenti quando ſi applicano ai tronchi nervoſi. Ma coſa non ſi può mai objettare quando ſi vuol ſemplicemente objettare, e imaginar delle difficoltà? La più piccola circoſtanza variata baſta allora; e chi non ſa trovar varietà quando è ſi difficile, che due coſe ſieno in tutto ſimili affatto? In quanto a me oſſervo che la ſoſtanza interna dei nervi non ſi vede diverſa da quello che è alle eſtremità di eſſi nervi, che il tronco è ſoggetto al dolore come lo ſono le eſtremità, e che non immagino ipoteſi, che i fatti non confermino.

Nella generalità delle illazioni, che deduco dalle mie eſperienze poſſo eſſermi ingannato, e poſſo eſſermi ingannato ancora in qualcuna delle eſperienze medeſime, benchè abbia procurato di farle bene, ed abbia cercato la verità, ſenza prevenzione. Non dubito che chi vorrà applicarſi a queſte ricerche dopo di me non trovi delle coſe da aggiugnere, e forſe ancora da correggere. A me baſta di aver aperto una ſtrada a nuove verità, e che i fatti principali che avanzo ſiano veri.

La

La piu gran parte di queste mie esperienze sono state fatte alla presenza di Mr. INGENHOUSZ, medico delle LL.MM. Cesaree, mio particolare amico, e uomo, che ha mostrato in piu opere il talento raro di osservatore. Il Sig. TIBERIO CAVALLO si è trovato presente anche egli a molte delle piu importanti. Ho creduto coll' autorita di due persone conosciute dai dotti di conciliare piu di credito alle mie esperienze.

Dopo aver finito le mie esperienze sopra il veleno Americano un mio amico a Londra mi ha procurato un gran numero di freccie dell' Indie orientali. Ho voluto fare qualche esperienza ancora sopra di esse, ma le mie esperienze non sono nè molte, nè variate, si perchè mi è parso, che questo veleno non fosse differente dall' altro, che per la minore attività, che mi ha dimostrato nell' uccidere gli animali. E questa minore attività probabilmente si deve attribuire, o perchè le freccie sono state piu mal conservate, che quelle dell' Indie occidentali, come pareva veramente, o perchè quel veleno era stato preparato molti anni prima.

Non mi è mai riuscito di far morire alcun cuniglio nè anco de' mezzani coll' applicarlo alla cute sfregata, o leggiermente tagliata. Benchè metessi di quel veleno in piu gran quantità, e sopra parti di pelle piu estese, che del veleno Ticunas, non produsse alcuna alterazione sen-

sibile

sibile nè anco nei cunigli, che non pesavano, che appena una libbra.

Traforai colle freccie la pelle a piu animali, e ve la lasciai per giorni intieri, senza che potessi accorgermi, che gli animali fossero affetti del veleno; ma gli effetti del veleno furono bensi osservati, quando traforavo i muscoli colle freccie, e ve le lasciavo dentro di essi. Vari animali morirono in questa maniera, e morirono tutti con segni manifesti di veleno, e coi medesimi segni o sintomi, coi quali muojoni gli animali per il veleno Americano. E bensi vero, che nessuno morì, o mostrò di star male sensibilmente, che dopo piu ore, talchè pare che questo veleno non differisca essenzialmente dall' altro, e conviene con esso affatto, quando si osserva col microscopio, quando si mescola col turnesole, quando si getta sugli occhi degli animali, e quando si assapora colla lingua, e si mastica fra denti; è per altro vero, che nell' acqua si scioglie men bene dell' altro veleno, che anzi la maggior parte resta insolubile a quel fluido. L'unica illazione, che si può dedurre dai fatti riportati sopra, è che il veleno comunicato ai muscoli è molto piu micidiale, che applicato alla pelle, che conviene molto bene agli altri veleni, e che sempre piu ci persuase, che l'azione immediata dei veleni non è contro dei nervi,

giacchè

giacchè è certo, che la pelle è piu ſenſibile dei muſcoli, e che è tutta inteſſuta di nervi.

Alcune poche eſperienze feci ancora ſopra l'olio di tabacco, i riſultati delle quali ho creduto bene di dover qui accennare brevemente.

Eſperienze fatte coll' olio di tabacco.

Feci un piccolo taglio ſopra la coſcia deſtra di un Piccione, e vi applicai una goccia di olio di tabacco: dopo due minuti perdette il moto della zampa deſtra.

Ripetei la medeſima eſperienza ſopra di un altro Piccione, e l'eſito fù affatto il medeſimo.

Ferii con picciol taglio i muſcoli del petto d'un Piccione, e applicato alla ferita l'olio di tabacco, dopo trè minuti l'animale non poteva piu reggerſi ſulla zampa ſiniſtra.

Queſta medeſima eſperienza fu replicata ſopra di un altro Piccione, col medeſimo ſucceſſo.

Inſinuai nei muſcoli del petto d'un Piccione uno ſtecco inzuppato nell' olio di tabacco, e il Piccione, dopo pochi ſecondi cadde, come ſe foſſe ſtato morto.

Due altri Piccioni, ai muſcoli de quali avevo applicato l'olio di tabacco vomitorono piu volte tutto ciò che avevano mangiato.

Due altri trattati come sopra, ma a stomaco vuoto fecero sforzi per vomitare.

In generale ho osservato, che il vomito è l'effetto piu costante di questo olio, ma che la perdita del moto nella parte opposta del veleno non è che accidentale.

Nessuno poi degli animali, a cui applicai l'olio di tabacco morì.

Sopra l'acqua di Lauro Ceraso.

Finirò le mie esperienze sopra i veleni col riportarne alcune che ne ho fatte sopra un veleno divenuto celebre in Europa da qualche anno addietro. Questo veleno è l'acqua di Lauro Ceraso, che non la cede a nessun' altro dei piu attivi veleni, se si considera relativamente ai piu gravi sconcerti che apporta all' economia animale, e al breve tempo, in cui agisce quando si da per bocca agli animali. Egli produce non solo le piu forti convulsioni, e fino la morte, anche negli animali mediocremente grandi, ma di piu se viene dato in dose minore, l'animale si torce all' indietro accostando il capo alla coda, e inarca all' infuori talmente le vertebre, che fa orrore a vederlo in quello stato: le convulsioni, e i moti di tutto il corpo sono de piu violenti, e fra tanti sforzi muore alla fine l'animale dopo breve tempo. Se si da all' animale alla maniera di Clistere produce egualmente le convulsioni, e la morte. Con due soli cucchiaini

ini da Tè di quell' acqua data per bocca, ho veduto dei cunigli di mediocre grandezza cader convulsi in meno di 30 secondi, e morire dentro un minuto. Se si da quell' acqua in gran quantità agli animali, muojono quasi nell' istante, e muojono, senza convulsioni, colle parti rilasciate, e cadenti.

Quando si da in poca quantità, le convulsioni sono piu, o meno grandi, e le parti, che perdono prima delle altre il moto, sono le zampe di dietro, e viene in appresso quelle davanti, che muojon piu tardi. Quando l'animale non muove piu le zampe, e il resto del corpo, muove ancora benissimo il collo, e il capo, che seguita ad alzare con forza, e a volgere per tutto. In questo stato l'animale sente il suono, e vede gli oggetti; benchè non muova piu le zampe da per se, arriva per altro a muoverle, e a ritirarle quando si pungono forte, o si comprimano molto: segno, che può moverle, benchè non le muova, che per gran dolore.

L'acqua di Lauro Ceraso è adunque un potentissimo veleno data per bocca, o introdotta nel corpo a foggia di Clistere. La sua azione è si violenta, e si pronta, che si direbbe, che comincia ad agire nel momento, che l'animale la riceve per la bocca: certo è, che appena è entrata per l'esofago nel ventricolo, che l'animale patisce. E per altro vero, che una piccola dose non fa nulla, cioè poche gocciole date ad un animale piccolo, che sarebbe morto

ſe foſſe ſtato del veleno Ticunas, non par che produca alcuno ſconcerto ſenſibile. Ma tutto queſto non fa una differenza eſſenziale fra quel veleno, e gli altri veleni piu conoſciuti.

Io ho oſſervato, che mettendo una certa quantità di acqua nelle fogli di Lauro Ceraſo ſi ottiene un liquore affatto innocente, ſe le foglie non ſono moltiſſime, e ſe l'acqua non è in piccoliſſima doſe. Se ſi diſtilla ancora piu volte ſucceſſivamente quell' acqua ſopra le medeſime foglie, diventa è vero piu attiva, ma non per queſto uccide ancora, ma ſe invece di unire al Lauro Ceraſo dell' acqua ſi fa una diſtillazione a bagno maria, e ſi riceve l'umore diſtillato in queſta maniera; egli è allora un potentiſſimo veleno, che uccide in breviſſimo tempo. Di queſto io ho fatto uſo principalmente, ma non dubito punto, che non ſi poteſſe portare a tale attività da uccidere anche dato in piccola doſe, come accade del veleno Americano. Baſterebbe ridiſtillare piu volte ſopra nuovo Lauro Ceraſo bene aſciutto, e quaſi diſeccato, il liquore ſortito la prima volta: io credo che ſi otterrebbe alla fine ſotto la forma d'una ſoſtanza oleoſa concreta, la quale ſe ſi faceſſe evaporare al fuoco, non ſolo non la cederebbe a neſſuno dei veleni conoſciuti, ma ſarebbe ſuperiore a tutti gli altri di gran lunga. Mi riſervo di far queſta eſperienza in un altra occaſione, nella quale parlerò ancora delle mandorle

amare, e fino a qual grado di veleno si può portare la loro acqua distillata a secco.

L'acqua di Lauro Ceraso uccide gli animali introdotta nelle cavità del corpo, ma quali effetti produce ella quando si applica alle ferite? Tra le diverse esperienze, che io feci, basterà di accennarne qui una sola. Aprii la pelle del basso ventre ad un cuniglio piuttosto grande, e la ferita fù circa un pollice. Ferii legermente i sottoposti muscoli in piu luoghi, e vi insinuai circa due, o tre chucchiajni da cassè di quell' acqua; in meno di tre minuti l'animale cadde in convulsione, e poco dopo morì. Questa esperienza ci fa vedere che l'acqua di Lauro Ceraso è un veleno simile agli altri, e che agisce quando s'introduce nel corpo, per mezzo di ferite. Questa esperienza ha avuto il medesimo risultato in altri animali a sangue caldo, ma in tutti hò però trovato, che l'acqua di Lauro Ceraso agisce data per bocca con piu di forza, e piu presto, data ancora in poca quantità; la qual cosa merita, a mio credere, la piu grande attenzione, perchè alla fine è una verità di fatto, che una gran ferita presenta incomparabilmente piu di vasi per assorbire quel veleno quasi in momenti, che la bocca, il ventricolo, e le parti nervose ancora nelle ferite, per lo stato, in cui si trovano allora, devono sentir piu facilmente l'azione di quel veleno. Nè solo gli animali a sangue caldo muojono prestissimo quando

quando si fan bere di quell' acqua, ma gli stessi animale a sangue freddo muojono anche essi, e quello che mi è parso singulare è che muojono in breviſſimo tempo, e forse anche piu presto, che è tutto il contrario negli altri veleni. Mi basterà ora di parlare delle anguille, animali difficiliſſimi a morire, e che morti ancora durano a muoversi per lungo tempo le loro parte. Questi animali muojono dopo pochi secondi che han bevuto di quell' acqua, e appena bevuta cominciano già a contrarsi, ma la morte che sopravviene subito gli rende immobili un momento dopo, nè urtate le loro parti si muovono piu. Il cuore però seguita ancora a muoversi, ma molto meno di prima, e finisce di muoversi molto prima, che quando si fanno morire tagliando loro il capo. Qui non si può negare, che l'irritabilità muscolare non sia estremamente affetta, e in modo particolare. Non so se vi sia nessuno animale a sangue freddo, che resista a questo veleno. Quelli, che ho provato sono tutti morti, e dubito se ve ne sia nessuno, a cui non sia veleno. Se è così egli merita una distinzione aparte anche per questo, e sarebbe il piu terribile di tutti i veleni conosciuti, anche per la sua generalità di dar la morte a qualunque sorta di animale. Ma come mai può egli uccidere in si breve tempo, quando si prende per bocca, e va al ventricolo, dove non si suppone vasi capaci di riceverlo?

La

La difficoltà domanda qualche esperienza ulteriore. Bisogna vedere quali effetti produce quando è applicato immediatamente ai nervi, e quali effetti produce quando è introdotto nel sangue, senza toccare a parti tagliate.

Mi sono servito dei cunigli piu grandi, ed ho fatte le mie esperienze sopra i nervi sciatici di quegli animali nella stessa maniera che ho fatto col veleno della vipera, e col veleno Americano. Mi basterà di accennare qui una sola esperienza, che servirà per tutte le altre, le quali per brevità tralascio, non le credendo molto necessarie, dopo le moltissime, che ho riportate sopra i nervi.

Avendo scoperto il nervo sciatico ad un grosso cuniglio per piu d'un pollice e mezzo, infinuai sotto il medesimo un inviluppo di tela finissima raddoppiata 16 volte, acciocchè le parti sottoposte non fossero penetrate dall' acqua di Lauro Ceraso. Ferii allora il nervo di diversi colpi di lancetta fatti lungo il nervo medesimo e coprii tutto il tratto delle parti ferite, che era piu di otto linee, di un ammasso di cotone grosso circa 3 linee, e ben inzuppato dell' acqua di Lauro Ceraso. Piu di 15 gocciole di quell' acqua vi vollero per inumidir il cotone, e quest' acqua andava direttamente a comunicarsi per le ferite della lancetta alla sostanza midollare del nervo sciatico. Coprii ogni cosa dopo qualche minuto con nuovi cenci in modo, che era impossibile, che l'acqua del Lauro Ceraso

si

ſi comunicaſſe alle parti ſottopoſte, o vicine. Fatta la cucitura eſterna, e laſciato in libertà l'animale non parve, che aveſſe ſofferto nulla, ne in appreſſo moſtrò di avere alcun male. Correva, mangiava, ed era coſi vivace, che prima: in ſomma queſto animale non ſoffri nulla ſenſimente da quel veleno, che preſo per bocca uccide ſi preſto. Queſto fatto è molto analogo, come molti altri, a quelli del veleno della vipera, e del veleno Americano, e ci fa vedere, che l'acqua di Lauro Ceraſo applicata immediatamente ſopra i nervi, e fino inſinuata dentro la ſoſtanza midollare di eſſi; non è veleno per neſſun modo, onde, che non ha alcuna azione ſopra i nervi comunque vi ſi applichi eſternamente.

Dopo tante eſperienze riportate nel decorſo di queſta memoria ſopra il veleno della vipera, e ſopra il veleno Americano ancor piu potente del primo, e dopo di aver veduto, che nè l'uno, nè l'altro di queſti due veleni hanno azione alcuna ſopra i nervi, quando vi ſi applica immediatamente, nel tempo che introdotti nel ſangue uccidono immediatamente gli animali piu forti; neſſuna altra coſa era piu naturale che di dedurre, che ancora il veleno del Lauro Ceraſo il quale è innocente applicato egualmente che gli altri ai nervi, doveſſe uccidere quando é introdotto nel ſangue; eppure la coſa è affatto diverſamente, tanto è vero, che biſogna diffidare dell' analogia anche allor

allor che pare piu uniforme. Io ho introdotto per le jugulari l'acqua di Lauro Ceraſo in un groſſo cuniglio, ne ho introdotto la prima volta cinque e piu gocciole nella medeſima maniera, che avevo introdotto il veleno della vipera, e il veleno Americano. L'animale non ha fatto alcun ſegno di ſoffrire; ho creduto di aver male operato, ho creduto di non avere introdotto nulla per quei vaſi, mi ſono immaginato, che la ſciringa ſi foſſe inſinuata per la cellulare: ho ripetuta l'eſperienza, ho introdotto di nuovo per la jugulare una quantità di veleno, forſe 3, in 4 volte maggiore, mi ſono aſſicurato prima d'introdurre il veleno, che la punta della mia ſciringa entrava nella jugulare, e che il veleno non poteva tornare a dietro per neſſun conto, ma l'animale non ha moſtrato di ſoffrir nulla per queſto, ed era dopo coſi vivace che prima. Io ero piutoſto maravigliato di tutto queſto, che ſodisfatto. Non ſapevo perſuadermi che l'acqua di Lauro Ceraſo non doveſſe eſſer veleno, e un veleno potentiſſimo appena introdotta nel ſangue, quando era veleno applicata alle carni ferite, e preſa per bocca, e nel' tempo ſteſſo inattiva e innocente meſſa ſopra i nervi. Ripetei adunque le eſperienze, e introduſſi queſta volta per le jugulari un intiero cucchiaio da Tè di acqua di Lauro Ceraſo: l'animale non ſoffrì nulla, ed era tanto ſano, che prima. Replicai queſta eſperienza in un altro

cuniglio, a cui pure introduſſi per le jugulari un buon cucchiajo da Tè di queſto ſteſſo veleno: il cuniglio non dette alcun ſegno di ſoffrire nè allora, nè dopo.

L'eſito inaſpettato di queſte eſperienze mi getta nella più grande incertezza intorno all' azione di quel veleno, nè ſo intendere non ſolo in quel maniera opera, ma nè anco ſopra quali parti agiſca, quando ſi prende per bocca, o ſi applica alle ferite. Qui tutto ſi confonde. Non ſi vede che agiſca ſu i nervi, non ha azione alcuna ſul ſangue, eppure uccide, e uccide in iſtanti, ſe ſi introduce per la bocca nel ventricolo.

Vi è egli dunque una nuova via per introdurſi la morte negli animale oltre quella del ſangue, e dei nervi? Il moto perduto, e perduto in pochi ſecondi in animali, come ſono le anguille, che ſeguitano a muoverſi per ore dopo reciſa la teſta, e dopo tagliate in pezzi, farebbe credere, che l'irritabilità della fibra muſcolare foſſe affetta da quel veleno. E vero, che il cuore ſeguita ancora a muoverſi in quegli animali, ma il moto nè moltiſſimo diminuito, ed è di breve durata. Negli animali caldi morti per quel veleno ſuſſiſte ancora il moto, benchè pochiſſimo, e ſe il cuore in eſſi dura a battere per qualche tempo, batte meno forte, che quando ſi fanno morire in altre maniere. L'irritabilita è ſicuramente diminuita moltiſſimo in molti animali, e in molti altri affatto diſ-

tratta,

tratta, comunque poi essa possa contribuire alla morte, e uccidere in sì breve tempo, e comunque sia oscura il meccanismo, per cui la fibra muscolare perde la sua irritabilità. Bisogna confessare la nostra ignoranza nelle ricerche della natura. Quando crediamo di aver tutto fatto ci troviamo spesso ritornati d'onde siamo partite. L'esperienza è la sola guida, che abbiamo nelle nostre ricerche; l'esperienza, è vero, è un mezzo sicuro, per non cader nell' errore, ma l'esperienza non sempre ci porta alle verità più remote, non sempre ci guida alla conoscenza dei nascosti arcani della natura, nè sempre ci conduce, dove ci eramo proposti di andare.

Ma se noi non sappiamo, come operi l'acqua di Lauro Ceraso, o per meglio dire sopra quali parti quel veleno eserciti la sua azione, quando uccide gli animali, sappiamo però, che applicato immediatamente ai nervi, e fino alla parte midollare di essi è affatto innocente, e non è men vero tutto quello che tante esperienze riportate sopra ci hanno dimostrato chiaramente, che il veleno della vipera, e il veleno Americano non sono veleno, applicati comunque ai nervi, ma che lo sono allora che sono introdotti nel sangue. Questi sono fatti prima ignoti, son verità ora, nè si possono rivocare in dubbio da chi che sia. Questi fatti distruggono tutti i sistemi inventati dagli scrittori sopra l'azione di quei veleni, e da questi fatti dobbiamo

partire per l'intelligenza di quei veleni, e della loro azione.

Qualche lume avrei probabilmente potuto cavare sopra l'azione del veleno di Lauro Ceraso, se lo avessi potuto applicare alle diverse parti del cervello nell' animale vivente, ma mi riservo di farlo quando avrò più comodo che al presente, e quando avrò ridotto a consistenza di sciroppo l'acqua di Lauro Ceraso. In quello stato reso assai più attivo quel veleno potrà facilmente presentarmi dei fatti nuovi, e più interessanti, e potrà forse darmi dei lumi meno equivoci sopra la sua azione, e farmi giudicare sopra quali parti dell' animale vivente agisce per uccidere. In questa medesima occasione io mi riserverò di esaminare se quel veleno agisce sopra i vasi linfatici, o per meglio dire sopra la linfa medesima. Questo è un semplice sospetto, che mi è venuto dopo, e che le presenti mie circostanze non mi permettano per ora di esaminare. Sono adunque sforzato di dare le mie esperienze sopra questo soggetto in parte mancanti, e difettose. Andavano più moltiplicate, più seguite, che non ho potuto fare; ed è questa appunto una ragione di più, perchè io ritorni a trattar di nuovo questa materia, che non lascia di essere interessante.

XII. *A Conjecture concerning the Method by which* Cardan's *Rules for reſolving the Cubic Equation* $x^3+qx=r$ *in all caſes (or in all magnitudes of the known quantities* q *and* r*) and the Cubic Equation* $x^3-qx=r$ *in the firſt Caſe of it (or when* r *is greater than* $\frac{2q\sqrt{q}}{3\sqrt{3}}$*, or* $\frac{rr}{4}$ *is greater than* $\frac{q^3}{27}$*) were probably diſcovered by* Scipio Ferreus, *of* Bononia, *or whoever elſe was the firſt Inventor of them. By* Francis Maſeres, *Eſq. F. R. S. Curſitor Baron of the Exchequer.*

Read January 27, 1780.

ARTICLE I.

THERE is nothing more amuſing, or more grateful to an inquiſitive mind, in the ſtudy of the ſciences of Geometry and Algebra (for if we baniſh from it the ridiculous myſteries ariſing from the ſuppoſition of *negative* quantities, or quantities *leſs than nothing*, the latter may deſerve the name of a *ſcience* as well as the former) than to contemplate the methods by which the ſeveral ingenious and ſurprizing truths that are delivered in the books

books that treat of them were firſt diſcovered. This we are ſometimes enabled to do by the authors themſelves to whom we are indebted for theſe diſcoveries, who have candidly informed their readers of the ſeveral ſteps, and ſometimes of the accidents, by which they have been led to them: but it alſo often happens, that the authors of theſe diſcoveries have neglected to give their readers this ſatiſfaction, and have contented themſelves with either barely delivering the propoſitions they have found out, without any demonſtrations, or with giving formal and poſitive demonſtrations of them, which command indeed the aſſent of the underſtanding to their truth, but afford no clue whereby to diſcover the train of reaſoning by which they were firſt found out; and conſequently contribute but little to enable the reader to make ſimilar diſcoveries himſelf on the like ſubjects. This ſeems to be the caſe with thoſe ingenious rules for the reſolution of certain cubic equations, which are uſually known by the name of CARDAN's rules. We are told to make certain ſubſtitutions of ſome quantities for others in theſe equations $x^3+qx=r$ and $x^3-qx=r$ (which are the objects of thoſe rules) and certain ſuppoſitions concerning the quantities ſo ſubſtituted; by doing which we find, that thoſe equations will be transformed into other equations which will involve the ſixth power of the unknown quantity

tity contained in them, but which (though of double the dimenſions of the original equations $x^3+qx=r$ and $x^3-qx=r$, from which they were derived) will be more eaſy to reſolve than thoſe equations, becauſe they will contain only the ſixth power and the cube of the unknown quantity which is their root, and conſequently will be of the ſame form as quadratic equations; ſo that by reſolving them as quadratic equations we may obtain the value of the cube of the unknown quantity which is their root, and afterwards, by extracting the cube-root of the ſaid value, we may obtain the value of the ſaid root, or unknown quantity, itſelf; and then at laſt, by the relation of this laſt root to x, or the root of the original equation, (which relation is derived from the ſuppoſitions that have been made in the courſe of the preceding tranſformations) we may determine the value of x. And, if we pleaſe to examine the ſeveral ſteps of this proceſs with ſufficient attention, we may perceive, as we go along, that all theſe ſubſtitutions are legitimate and practicable, or are founded upon poſſible ſuppoſitions; though I cannot but obſerve, that the writers on algebra, for the moſt part, have not been ſo kind as to ſhew us that they are ſo. But ſtill the queſtion recurs, "How came SCIPIO "FERREUS, of Bononia (who, as CARDAN tells us, was "the firſt inventor of theſe rules) or the other perſon, "whoever

" whoever he was, that invented them, to think of mak-
" ing theſe lucky ſubſtitutions which thus transform the
" original cubic equations into equations of the ſixth
" power which contain only the ſixth and third powers
" of the unknown quantities which are their roots, and
" conſequently are of the form of quadratic equations?"
To anſwer this queſtion as well as I can *by conjecture* (for I know of no hiſtorical account of this matter in any book of algebra) and in a manner that appears to me to be *probable*, is the deſign of the following pages.

2. The moſt probable conjecture concerning the invention of theſe rules, called CARDAN's rules, by SCIPIO FERREUS, of Bononia, or whoever elſe was the inventor of them, ſeems to be this: that the ſaid inventor tried a great variety of methods of reducing the three cubic equations of the third claſs, to wit, $x^3+qx=r$ and $x^3-qx=r$, and $qx-x^3=r$ (to ſome one of which all other cubic equations may, by proper ſubſtitutions, be reduced) to a lower degree, or to a more ſimple form, by ſubſtituting various quantities in the ſtead of x, in hopes that ſome of the terms ariſing by ſuch ſubſtitutions might be equal to others of them, and, having contrary ſigns prefixed to them, might deſtroy them, and thereby render the new equation more ſimple and manageable than the old one. And, amongſt other trials, it ſeems natural to

imagine, that he would ſubſtitute the ſum or difference of two other quantities inſtead of x, as being the moſt ſimple and obvious ſubſtitutions that could be made. And by making theſe ſubſtitutions, the above mentioned rules would of courſe come to be diſcovered, as well as the aforeſaid limitation of them in the reſolution of the equation $x^3-qx=r$, which reſtrains the rule to thoſe caſes only in which r is greater than $\frac{2q\sqrt{q}}{3\sqrt{3}}$, or $\frac{rr}{4}$ is greater than $\frac{q^3}{27}$, and their utter inutility in all the caſes of the equation $qx-x^3=r$. This will appear by examining each of theſe equations ſeparately in the following manner.

Of the equation $x^3+qx=r$.

ART. 3. In the equation $x^3+qx=r$ the inveſtigator of theſe rules would naturally be inclined to ſubſtitute the difference of two quantities (which we will here call y and z, and of which we will ſuppoſe y to be the greater) inſtead of x, rather than their ſum, or would ſuppoſe x to be equal to $y-z$, rather than to $y+z$; becauſe, if he was to ſuppoſe x to be equal to the ſum of the two quantities y and z, and was to ſubſtitute that ſum, or the binomial quantity $y+z$, inſtead of x in the equation $x^3+qx=r$, it is evident, that (as the ſigns of x^3 and qx

are, both of them, affirmative) the terms of the new equation, arising from such substitution, would all of them be likewise affirmative; and consequently none of them, though they should happen to be exactly equal to each other, could exterminate each other, and thereby render the new equation more simple than the old one, which was the only view with which the substitution would have been made. He would, therefore, suppose x to be equal to $y-z$; and by substituting this quantity instead of x in the original equation $x^3+qx=r$, he would transform that equation into the following one, to wit,

$$y^3-3yyz+3yzz-z^3+qy-qz=r,$$

$$\text{or } y^3-3yz\times\overline{y-z}-z^3+q\times\overline{y-z}=r.$$

Now in this equation it is evident, that the terms $3yz\times\overline{y-z}$ and $q\times\overline{y-z}$ have contrary signs; and therefore, if their co-efficients $3yz$ and q can be supposed to be equal to each other, those terms will mutually destroy each other, and the equation will be reduced to the following short one, $y^3-z^3=r$. And if in this equation we substitute, instead of z, its value $\frac{q}{3y}$, derived from the same supposition of the equality of q and $3yz$, the equation will be $y^3-\frac{q^3}{27y^3}=r$; and, by multiplying both sides by y^3, it will be $y^6-\frac{q^3}{27}=ry^3$; which equation, though it rises to the sixth power of the unknown quantity y, is

evidently of the form of a quadratic equation, and may therefore be reſolved, ſo far as to find the value of the cube of y, in the ſame manner as a quadratic equation; after which it will be poſſible to find the value of y itſelf by the mere extraction of the cube root; and then at laſt, from the relation of y to x (derived from the foregoing ſuppoſitions that $y-z$ was equal to x, and that $3yz$ was equal to q, and conſequently z equal to $\frac{q}{3y}$) we ſhall be able to determine the value of x.

Art. 4. It would therefore remain for the inveſtigator of this method to inquire, whether or no the ſuppoſition, "that $3yz$ was equal to q," was a poſſible ſuppoſition; that is, whether it was poſſible (whatever might be the magnitudes of q and r) for two quantities, y and z, to exiſt, whoſe nature ſhould be ſuch that their difference $y-z$ ſhould be equal to the unknown quantity x in the equation $x^3+qx=r$, and that three times their product ſhould at the ſame time be equal to q, or their ſimple product to the third part of q. And this ſuppoſition he would ſoon find to be always poſſible, whatever may be the magnitudes of q and r; becauſe, if the leſſer quantity z is ſuppoſed to increaſe from o *ad infinitum*, and the greater quantity y is likewiſe ſuppoſed to increaſe with equal ſwiftneſs, or to receive equal increments in the ſame

times, and thereby to preſerve their difference $y-z$ always of the ſame magnitude, or equal to x, it is evident that the product or rectangle yz will increaſe continually at the ſame time from 0 *ad infinitum*, and conſequently will paſs ſucceſſively through all degrees of magnitude, and therefore muſt at one point of time during its increaſe become equal to $\frac{q}{3}$.

And having thus found this ſuppoſition of the equality of yz and $\frac{q}{3}$, or of $3yz$ and q, to be always poſſible, whatever might be the magnitudes of q and r, our inveſtigator would juſtly conſider his ſolution of the equation $x^3+qx=r$ (which was founded on that ſuppoſition) as legitimate and compleat. And thus we ſee in what manner it ſeems probable, that CARDAN's rule for reſolving the cubic equation $x^3+qx=r$ may have been diſcovered.

Of the equation $x^3-qx=r$.

Art. 5. In this ſecond equation $x^3-qx=r$, in which the ſecond term qx is ſubtracted from the firſt, or marked with the ſign $-$, it ſeems to have been natural for the perſon who invented theſe rules to ſubſtitute the *ſum* as well as the *difference* of two other quantities, y and z, inſtead

ſtead of x, in the terms x^3 and qx, in hopes of ſuch an extermination of equal terms, and conſequential reduction of the equation to one of a ſimpler and more manageable form, as was found to be ſo uſeful in the caſe of the former equation $x^3+qx=r$. We will therefore try both theſe ſubſtitutions; and, as that of the difference $y-z$ has in the former caſe proved ſo ſucceſsful, we will begin by that.

Art. 6. Now, by ſubſtituting the difference $y-z$ inſtead of x in the equation $x^3-qx=r$, we ſhall transform it into the following equation, to wit, $y^3-3yyz+3yzz-z^3-q\times\overline{y-z}=r$, or $y^3-3yz\times\overline{y-z}-z^3-q\times\overline{y-z}=r$; in which the terms $3yz\times\overline{y-z}$ and $q\times\overline{y-z}$ have both of them the ſame ſign $-$ prefixed to them, and conſequently can never exterminate each other, whether $3yz$ be equal or unequal to q. This ſubſtitution therefore is in this caſe of no uſe.

Art. 7. We will now therefore try the ſubſtitution of the *ſum* of y and z, inſtead of their difference, in the equation $x^3-qx=r$.

Now, if x be ſuppoſed to be equal to $y+z$, and $y+z$ be ſubſtituted inſtead of it in the equation $x^3-qx=r$, that equation will be thereby transformed into the following one, to wit,

y^3+

$$y^3+3yyz+3yzz+z^3-q\times\overline{y+z}=r,$$

$$\text{or } y^3+3yz\times\overline{y+z}+z^3-q\times\overline{y+z}=r.$$

Now in this equation, the terms $3yz\times\overline{y+z}$ and $q\times\overline{y+z}$ have contrary ſigns. Conſequently, if they can be ſuppoſed to be equal to each other, they will deſtroy each other, and the equation will be thereby reduced to the following ſhort one, $y^3+z^3=r$; that is, if $3yz$ and q can be ſuppoſed to be equal to each other, or if yz can be ſuppoſed to be equal to $\frac{q}{3}$, the equation will be reduced to the ſhort equation $y^3+z^3=r$. And, if in this ſhort equation we ſubſtitute, inſtead of z, its value $\frac{q}{3y}$ (derived from the ſame ſuppoſition of the equality of $3yz$ and q) the equation thence reſulting will be $y^3+\frac{q^3}{27y^3}=r$; and by multiplying both ſides by y^3, it will be $y^6+\frac{q^3}{27}=ry^3$; and, by ſubtracting y^6 from both ſides, it will be $ry^3-y^6=\frac{q^3}{27}$; which, though it riſes to the ſixth power of y, is evidently of the form of a quadratic equation, and conſequently may be reſolved in the ſame manner as a quadratic equation, ſo far as to find the value of y^3, or the cube of the root y; after which it will be poſſible to find the value of y itſelf by the mere extraction of the cube root; and, laſtly, from the relation of y to x (contained in the two ſuppoſitions, that $y+z$ is equal to x, and that

$3yz$

$3yz$ is equal to q, and conſequently that z is equal to $\frac{q}{3y}$) we may determine the value of x.

Art. 8. The only thing, therefore, that would remain for the inveſtigator of theſe rules to do, in order to know whether the foregoing method of reſolving the equation $x^3+qx=r$ was practicable or not, would be to inquire, whether it was poſſible in all caſes, that is, in all magnitudes of the known quantities q and r, for $3yz$ to be equal to q, or for yz (or the product or rectangle of the two quantities y and z, whoſe ſum is equal to x) to be equal to $\frac{q}{3}$, and, if it was not poſſible in all caſes, but only in ſome, to determine in what caſes it *was* poſſible, or what muſt be the relation between q and r to make it poſſible.

Art. 9. Now, in order to determine this queſtion, it would be proper and natural to obſerve, that the quantity yz, or the product of the two quantities y and z, whoſe ſum is ſuppoſed to be equal to x, can never be greater than the ſquare of half that ſum, that is, than the ſquare of $\frac{x}{2}$, or than $\frac{xx}{4}$, by El. 2, 5, but may be of any magnitude that does not exceed that ſquare. Therefore, if $\frac{q}{3}$ is greater than $\frac{xx}{4}$, it will be impoſſible for yz to be equal to it; but, if $\frac{q}{3}$ is either equal to, or leſs than,

$\frac{xx}{4}$,

$\frac{xx}{4}$, it will be poſſible for yx to be equal to it, and if $\frac{q}{3}$ is exactly equal to $\frac{xx}{4}$, z will be exactly equal to y, and each of them equal to one half of x. We muſt, therefore, inquire what is the magnitude of x when $\frac{q}{3}$ is equal to $\frac{xx}{4}$. Now, when $\frac{xx}{4}$ is $= \frac{q}{3}$, xx will be $= \frac{4q}{3}$, and $x = \frac{2\sqrt{q}}{\sqrt{3}}$: therefore, when x is leſs than $\frac{2\sqrt{q}}{\sqrt{3}}$, it will be impoſſible for yz to be equal to $\frac{q}{3}$; but when x is greater than $\frac{2\sqrt{q}}{\sqrt{3}}$, it will be poſſible for yz to be equal to $\frac{q}{3}$.

But when x is $= \frac{2\sqrt{q}}{\sqrt{3}}$, x^3 will be $= \frac{8q\sqrt{q}}{3\sqrt{3}}$, and qx will be $= \frac{2q\sqrt{q}}{\sqrt{3}}$ or $\frac{6q\sqrt{q}}{3\sqrt{3}}$, and conſequently $x^3 - qx$ will be $= \frac{8q\sqrt{q}}{3\sqrt{3}} - \frac{6q\sqrt{q}}{3\sqrt{3}} = \frac{2q\sqrt{q}}{3\sqrt{3}}$.

Therefore, if it be true (as we ſhall preſently ſee that it is) that while x increaſes from being equal to $\sqrt{q}$ (which is evidently its leaſt poſſible magnitude) to any other magnitude, the compound quantity $x^3 - qx$, or the exceſs of x^3 above qx, will alſo continually increaſe from 0 (to which it is equal when x is $= \sqrt{q}$, or xx is $= q$) to ſome correſpondent magnitude without ever decreaſing; it will follow that, when x is leſs than $\frac{2\sqrt{q}}{\sqrt{3}}$, the compound quantity $x^3 - qx$ will be leſs than $\frac{2q\sqrt{q}}{3\sqrt{3}}$; and when

x is

x is greater than $\frac{2\sqrt{q}}{\sqrt{3}}$, the compound quantity x^3-qx will be greater than $\frac{2q\sqrt{q}}{3\sqrt{3}}$; and, *è converſo*, if the compound quantity x^3-qx is leſs than $\frac{2q\sqrt{q}}{3\sqrt{3}}$, x will be leſs than $\frac{2\sqrt{q}}{\sqrt{3}}$; and, if the compound quantity x^3-qx is greater than $\frac{2q\sqrt{q}}{3\sqrt{3}}$, x will be greater than $\frac{2\sqrt{q}}{\sqrt{3}}$. Conſequently, if the compound quantity x^3-qx, or, its equal, the abſolute term r in the equation $x^3-qx=r$, is leſs than $\frac{2q\sqrt{q}}{3\sqrt{3}}$, or $\frac{rr}{4}$ is leſs than $\frac{q^3}{27}$, it will be impoſſible for yz to be equal to $\frac{q}{3}$; but, if x^3-qx, or r, is greater than $\frac{2q\sqrt{q}}{3\sqrt{3}}$, or $\frac{rr}{4}$ is greater than $\frac{q^3}{27}$, it will be poſſible for yz to be equal to $\frac{q}{3}$. Therefore, if x^3-qx, or r, is leſs than $\frac{2q\sqrt{q}}{3\sqrt{3}}$, or $\frac{rr}{4}$ is leſs than $\frac{q^3}{27}$, the foregoing method of reſolving the cubic equation $x^3-qx=r$ will be impracticable; but, if $x^3-qx=r$, or r, is greater than $\frac{2q\sqrt{q}}{3\sqrt{3}}$, or $\frac{rr}{4}$ is greater than $\frac{q^3}{27}$, it will be practicable.

Art. 10. It now only remains to be proved, that while x increaſes, from being equal to $\sqrt{q}$, *ad infinitum*, the compound quantity x^3-qx will likewiſe increaſe from o *ad infinitum*, without ever decreaſing. Now this may be demonſtrated as follows.

Art. 11. It is evident, that while x increaſes from being equal to $\sqrt{q}$ *ad infinitum*, both the quantities x^3 and qx will increaſe *ad infinitum* likewiſe. But it does not therefore follow, that the exceſs of x^3 above qx will continually increaſe at the ſame time. This will depend upon the relation of the contemporary increments of x^3 and qx: if the increment of x^3 in any given time is equal to the contemporary increment of qx, the compound quantity x^3-qx will neither increaſe nor decreaſe, but continue always of the ſame magnitude during the ſaid time, notwithſtanding the increaſe of x; if the former increment is leſs than the latter, the ſaid compound quantity will decreaſe; and, if it is greater, it will increaſe. We muſt therefore inquire, whether the increment of x^3 in any given time is greater or leſs than the contemporary increment of $q\dot{x}$.

Art. 12. Now, if $\dot{x}$ be put for the increment which x receives in any given time, the increment of x^3 in the ſame time will be the exceſs of $\overline{x+\dot{x}}|^3$ above x^3, that is, the exceſs of $x^3+3x^2\dot{x}+3x\dot{x}^2+\dot{x}^3$ above x^3; and the increment of qx in the ſame time will be the exceſs of $q\times\overline{x+\dot{x}}$, or $qx+q\dot{x}$, above qx; that is, the increment of x^3 will be $3x^2\dot{x}+3x\dot{x}^2+\dot{x}^3$, and that of qx will be $q\dot{x}$. Now in the equation $x^3-qx=r$ it is evident, that xx muſt be greater than q; for otherwiſe x^3 would not be greater than qx,

as

as it is ſuppoſed to be. Conſequently, $\dot{x}\dot{x}\times\dot{x}$ muſt be greater than $q\dot{x}$; and, *à fortiori*, $3x^2\dot{x}+3x\dot{x}^2+\dot{x}^3$ (which is more than triple of $x^2\dot{x}$) muſt be greater than $q\dot{x}$; that is, the increment of x^3 will be greater than the contemporary increment of qx. Therefore, the exceſs of x^3 above qx, or the compound quantity x^3-qx, will increaſe continually, without decreaſing, while x increaſes from $\sqrt{q}$ *ad infinitum*. Q. E. D.

Art. 13. It follows, therefore, upon the whole of theſe inquiries, that if the compound quantity x^3-qx, or, its equal, the abſolute term r, is leſs than $\frac{2q\sqrt{q}}{3\sqrt{3}}$, or $\frac{rr}{4}$ is leſs than $\frac{q^3}{27}$, it will be impoſſible for yz to be equal to $\frac{q}{3}$, and conſequently the foregoing method of reſolving the equation $x^3-qx=r$ will be impracticable; but, if x^3-qx or r is greater than $\frac{2q\sqrt{q}}{3\sqrt{3}}$, or $\frac{rr}{4}$ is greater than $\frac{q^3}{27}$, it will be poſſible for yz to be equal to $\frac{q}{3}$, and conſequently, the foregoing method of reſolving the equation $x^3-qx=r$ will be practicable. And thus we ſee in what manner it is probable that CARDAN's rule for reſolving the cubic equation $x^3-qx=r$ in the firſt caſe of it, or when r is greater than $\frac{2q\sqrt{q}}{3\sqrt{3}}$, or $\frac{rr}{4}$ is greater than $\frac{q^3}{27}$, together with the reſtriction of it to that firſt caſe, may have been diſcovered.

Of the Equation $qx-x^3=r$.

Art. 14. In the third equation $qx-x^3=r$ the terms x^3 and qx have different ſigns, as well as in the ſecond equation $x^3-qx=r$; and therefore it ſeems to have been natural for the inventor of CARDAN's rules to try both the ſubſtitutions of $y-z$ and $y+z$ inſtead of x in this equation, as well as in that ſecond equation, in hopes of an extermination of equal terms that are marked with contrary ſigns, and a conſequent reduction of the equation to another which, though of double the dimenſions of the equation $qx-x^3=r$, ſhould have been of a ſimpler form and more eaſy to be reſolved. But it will be found upon trial, that neither of theſe ſubſtitutions will anſwer the end propoſed.

Art. 15. For, in the firſt place, let us ſuppoſe x to be $=y-z$. Then we ſhall have $x^3=y^3-3yyz+3yz-z^3=y^3-3yz\times\overline{y-z}-z^3$, and $qx=q\times\overline{y-z}$, and conſequently $qx-x^3=q\times\overline{y-z}-y^3+3yz\times\overline{y-z}+z^3$. Therefore, $q\times\overline{y-z}-y^3+3yz\times\overline{y-z}+z^3$ will be $=r$. Now in this equation it is evident, the terms $q\times\overline{y-z}$ and $3yz\times\overline{y-z}$ have the ſame ſigns, and therefore can never deſtroy each other. Therefore, no ſuch method of reſolving this equation

$qx-x^3=r$ as was found above for the two former equations $x^3+qx=r$ and $x^3-qx=r$, can be obtained by ſubſtituting the difference $y-z$ in it inſtead of x.

Art. 16. We will now try the ſubſtitution of $y+z$ inſtead of x in the terms of this equation.

Now, if x be ſuppoſed to be $=y+z$, we ſhall have $x^3=y^3+3yyz+3yzz+z^3=y^3+3yz\times\overline{y+z}+z^3$, and $qx=q\times\overline{y+z}$, and conſequently, $qx-x^3=q\times\overline{y+z}-y^3-3yz\times\overline{y+z}-z^3$. Therefore, $q\times\overline{y+z}-y^3-3yz\times\overline{y+z}-z^3$ will be $=r$.

In this equation it is true indeed that the terms $q\times\overline{y+z}$ and $3yz\times\overline{y-z}$ have different ſigns. But they cannot be equal to each other: for, ſince the three terms y^3 and $3yz\times\overline{y-z}$ and z^3 are all marked with the ſign $-$, or are to be ſubtracted from the firſt term $q\times\overline{y+z}$, and the remainder is $=r$, it is evident, that $q\times\overline{y+z}$ muſt be greater than the ſum of all the three terms y^3, $3yz\times\overline{y+z}$, and z^3, taken together, and therefore, *à fortiori*, greater than $3yz\times\overline{y+z}$ alone. Therefore, no ſuch extermination of equal terms marked with contrary ſigns as took place in the transformed equations derived from the two former equations $x^3+qx=r$ and $x^3-qx=r$, can take place in this transformed equation derived from the equation $qx-x^3=r$ by ſubſtituting $y+z$ in its terms inſtead of x; and conſequently no ſuch method of reſolving the equation

tion $qx-x^3=r$ as has been found for the reſolution of the equations $x^3+qx=r$ and $x^3-qx=r$, can be obtained by means of that ſubſtitution.

Art. 17. Theſe are the methods of inveſtigation by which I conceive it to be probable, that CARDAN's rules for the reſolution of the cubic equations $x^3+qx=r$ and $x^3-qx=r$, together with the limitation of the rule relating to the latter of thoſe equations, and their inapplicability to the third equation $qx-x^3=r$, may have been diſcovered by the firſt inventor of them.

XIII. *A new Method of treating the* Fiſtula Lachrymalis. *By Mr.* William Blizard, *Surgeon, F. A. S.; communicated by Mr.* Joſeph Warner, *Surgeon, F. R. S.*

Read Feb. 24, 1780.

IN every period of the diſeaſe, termed *fiſtula lachrymalis*, there is underſtood to exiſt a degree of obſtruction in the naſal duct; ſo that more or leſs of the tears, mixed with the oily ſecretion of the ſebaceous glands of the eye-lids, and mucus of the internal ſurface of the lachrymal ſac, being prevented from paſſing into the noſe, are expelled through the lachrymal puncta upon the ſurface of the eye, and down the cheek.

Writers on ſurgery divide this diſeaſe into ſeveral ſtages; the firſt and moſt ſimple being that of obſtruction, with little or no inflammation; and ſo on, according to the degree or effect of inflammation, to the laſt ſtage, a ſloughy, ulcerated condition of the ſac and its integuments, with, now and then, a *caries* of the bony parts.

Though

Though the diſeaſe be frequently the effect of a *virus* in the habit, yet ſurgeons find, that ſometimes the cauſe is very ſimple, and eaſily to be conceived from the analogy of parts.

The membranous portions of the naſal duct and lachrymal ſac are a continuation of the pituitous membrane of the noſe. This membrane is exceedingly vaſcular, ſecretes a large quantity of mucus upon its internal ſurface, and is endued with a great degree of ſenſibility.

Experience ſhews the great defluxions that are oftentimes made upon the pituitous membrane; the increaſed ſecretion of mucus that happens upon the application of various ſtimulants; and the firm conſiſtence it often acquires from ſtagnation, abſorption, and evaporation of its thinner parts: moreover, that the membrane itſelf frequently becomes inflamed and thickened.

The duct and ſac may be affected through obſtructed perſpiration, &c.; and thickened from the turgid ſtate of their veſſels: the ſecretion of mucus may alſo be conſiderably augmented. From the thickened ſtate of the membrane of the duct, the fluids in the ſac paſs with difficulty: by retention, warmth, and abſorption, they are rendered viſcid; and the difficulty, that at firſt aroſe from the thickened ſtate of the membrane,

now ariſes from another cauſe, namely, the inſpiſſated ſtate of the fluids.

Theſe are, probably, the moſt ſimple cauſes of obſtruction in the naſal duct; but, from whatever cauſe the obſtruction had its origin, in its early ſtate, when unattended with a morbid change of the contiguous parts, it is conſidered as the firſt and moſt ſimple ſtage of the *fiſtula lachrymalis*. It is in this ſtage that the means of obviating the neceſſity of a troubleſome and uncertain operation ſhould be employed, with any rational expectation of ſucceſs.

The principal of theſe means are:

1. Compreſſion; declared by experienced practitioners to be injudicious.

2. The paſſing an inſtrument into the noſtril, and up the duct; an operation very painful to the patient, and exceedingly troubleſome to the operator.

3. The introducing a probe through one of the puncta into the duct, after M. ANEL's manner; by experience proved to be inadequate to the deſign.

4. The impelling a fluid, by a ſyringe, through one of the puncta, as directed by M. ANEL; allowed by judicious and experienced ſurgeons to be ſometimes uſeful.

On reflecting upon the laſt method, I was induced to think, that if a fluid, of a great degree of ſpecific

gravity, as quickſilver, could be paſſed through one of the puncta, ſo as to fill the ſac and duct, and preſs upon the obſtructed part, it might be reaſonably expected to remove the obſtruction in the firſt and ſimple ſtage of the diſeaſe; at leaſt, to have a much better chance of producing this effect than a watery fluid, urged through the punctum in an unfavourable direction: beſides, it would be no bar to the uſe of proper general means.

Flattered with the ſeeming reaſonableneſs of the ſuggeſtion, and convinced of the ſafety of the experiment, I reſolved on making a trial the firſt opportunity; which ſoon occurred to me.

Mr. M— B—, a ſadler, in Mark-Lane, had been troubled with a flux of tears and mucus down the cheek from the puncta of the right eye-lids, about ſeven months. There was a degree of ſwelling or diſtenſion of the ſac, attended with pain. Upon preſſing the ſac, much ropy fluid, of a whitiſh colour, was forced through the puncta. The diſcharge was always in greateſt abundance in the evening; at which time he had a dimneſs of ſight in that eye.

The uſual means had been employed, without ſucceſs, by his ſurgeon, who approved of the ſuggeſted experiment, and the patient agreed to have it tried.

Meſſ. NAIRNE and BLUNT provided an inſtrument for the purpoſe. It conſiſts of a fine ſteel pipe, a little curved,

cemented in a glaſs tube about ſix inches long. At the top of the tube is a wooden funnel; and at the bottom of this is a valve, which may be elevated by a ſilken ſtring that is conveyed through a hole in the brim of the funnel, and hangs down by the ſide of the tube (a).

The ſteel pipe was paſſed into the inferior punctum, without pain or difficulty. The quickſilver was then poured into the funnel, and let down the tube by pulling the ſtring of the valve. When the quickſilver regurgitated out by the ſuperior punctum, the inſtrument was withdrawn. The quickſilver lay in the ſac and duct, without exciting pain, about thirty hours, when it paſſed into the noſe, and the patient caught ſome of it in his hand.

I thought it beſt at this time not to compreſs the ſac; apprehending it would diſcharge the quickſilver through the puncta, and ſo fruſtrate the intention.

On the third day the operation was repeated; when, on gently compreſſing the ſac, ſome of the quickſilver paſſed into the noſe, and with it a piece of congealed whitiſh mucus. A ſmall quantity of the quickſilver, upon making the preſſure, returned through the puncta.

(a) I have deſcribed the inſtrument as it was uſed; but I have ſince thought, that it would not only be more ſimple but do as well without a valvular apparatus, the quickſilver being poured in by an aſſiſtant. (See the figure).

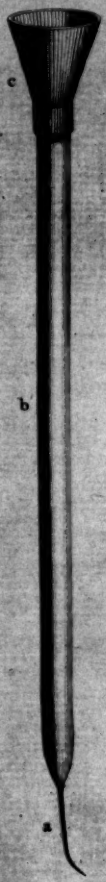
At the third and fourth times of repeating the operation, without any compreſſion, at intervals of a few days, the quickſilver paſſed readily into the noſe.

I once introduced the point of a ſteel pipe, uſed for injecting the lymphatic veſſels. It is cemented to a tube of glaſs eighteen inches long. This pipe is not ſo fine as that of the other inſtrument, yet it was conveyed into the punctum without difficulty, and with little or no pain. To gain a greater degree of *momentum* I raiſed the column of quickſilver to about twelve inches, when it flowed into the noſe with a conſiderable degree of velocity.

From the time that the quickſilver paſſed into the noſe, leſs fluid trickled down the cheek than before. After the ſecond or third operation, the ſwelling or diſtention of the ſac intirely ſubſided. The patient at this time has no diſcharge of mucus, and a tear but very ſeldom: the parts have a perfectly healthy appearance.

To aſcertain the effects of medicines in diſeaſes of the conſtitution, many experiments, under various circumſtances, are neceſſary; but in matters determinable by a mechanical operation, the effect, as far as our ſenſes can direct us, is in general very plain and explicable.

In the caſe related this is clear, namely, that previouſly to the injecting of quickſilver, the tears, ſebaceous matter,



a. *The Steel Pipe*

b. *The Glass Tube*

c. *The Funnel*

ter, and mucus, did not paſs through the naſal duct, or, but in a very ſmall proportion to the quantity ſecreted; that at the firſt experiment, quickſilver did not paſs; but that quickſilver, tears, &c., have ſince readily paſſed.

I cannot, however, flatter myſelf that this method will avail, except in the firſt or ſimple ſtage of the diſorder; but many caſes have a favourable ſtate for the trial in their early period, and that opportunity may be ſeized with a probability of ſucceſs.

The operation is ſimple, eaſily executed, productive of but little pain, and attended with no kind of danger.

XIV. *A Continuation of a Meteorological Diary, kept at* Fort St. George, *on the Coaſt of* Coromandel. *By Mr.* William Roxburgh, *Aſſiſtant-Surgeon to the Hoſpital at the ſaid Fort; communicated by* Joſeph Banks, *Eſq. P. R. S.*

Read January 20, 1780.

	Hour from Noon.	Therm. without	Therm. within.	Barom. in Inch. &20ths.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches.	In.			
Mar. 1	17	67	—	30.00		0	ESE	Fair.
	¼	86	80	30.00		2	ESE	Fair.
	10	78	80	30.00		2·	SE	Fair.
2	3	83	82	30.00		2·	SE	Fair.
	10	78	80	30.01		2·	SE	Fair.
3	17	75	80	30.01		·1	NW	Some clouds, no dew.
	0	85	82	30.00		2	SE	A few light clouds.
	11	79	81	30.00		·1	E	A few light clouds.
4	17	70	78	30.00		0	—	Fair.
	13	79	81	30.00		·1	E	Fair.
5	18	72	79	30.00		·1	SW	Fair, ſome dew.
	1	86	83	29.19		2·	S by W	A diſagreeable duſty Southerly wind, which we reckon the moſt unhealthy wind that blows.
	11	78	80	30.00		1·	SE	Fair.
6	18	70	78	29.19		0	—	Thick fog.
	1	85	—	29.·19		2	S	A diſagreeable Southerly wind.
	10	70	80	29.19		2	SSE	Fair.
7	17	70	77	29.19		0	—	Fair, much dew.
	3	83	82	29.19		2	SE	Fair.
	10	78	80	30.00		2	SE	Fair.

	Hour from Noon.	Therm. without	Therm. within.	Barom. in Inch. &20ths.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches.	In.			
Mar. 8	17	72	79	30.00		0	——	Fair, a good deal of dew.
	0	85	82	30.02		1	ESE	Fair.
9	17½	78	80	30.02		1·	SE	Cloudy, no dew.
	0	86	82	30.02·		1	E	Fair.
	10	78	81	30.02		1·	E	Fair.
10	18	70	77	30.02		·1	W	Fair.
	3	84	82	30.01		1·	E	Fair.
	10	78	80	30 03		1	ESE	Fair.
11	18	70	—			1	W	Fair.
	0	85	—			1	E	Fair.
	10	78	—			1	E	Fair.
12	18	70	—			0	——	Fair.
	10	78	80	30.02		1·	E	Fair.
13	17	68	76	30.02·		0	——	Fair, a little dew.
	1	85	81	30.0·1		1	ENE	Fair.
	10	79	80	30.02		·1	E	Fair.
14	18	70	78	30.01		·1	W	Fair.
	11	79	81	30.01		1	E	Fair.
15	18	72	79	30.00		·1	W	Fair.
	10	79	82	30.00		·1	N	Fair.
16	18	75	80	29.19		·1	W	Fair.
	0	87	84	30.00		2·	NNE	A few clouds.
	11	80	82	30.00		1	E	Fair, a very small shower at 5.
17	18	78	80	29.19		1	S	Black and threatening to the Southw.
	2	80	81	29.18·	0.14	0	——	Cloudy, rained hard about 9.
	10	76	81	29.19		0	——	Cloudy, very close.
18	17	72	80	29.19		0	——	Fair.
	½	85	82	29.19		1	E	Fair, feels exceedingly hot.
	11	79	81	29.19·		1·	SE	A few clouds.
19	17½	76	80	29.19		0	——	A few clouds.
	11	80	82	29.19·		1	ESE	A little haze.
20	18	73	80	29.19		0	——	Fair, a little dew.
	3	84	—	——		1·	SE	Fair.
	10	81	82	29.19		·1	ESE	Fair.
21	18	74	80	29.19		0	——	Fair.
	2	85	84	29.19		1	SE	Fair.
	10	81	83	30.00		1·	ESE	Fair.
22	18	76	81	29.19		0	——	Fair.
	½	85	84	29.·19		2	SE	Fair.
	10	81	82	29.19		1	ESE	Fair.

	Hour from Noon.	Therm. without	Therm. within.	Barom. in inch. &20ths.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches.	In.			
Mar. 23	18	73	81	29.19		0	——	Fair.
	10	79	82	29.19		1	SE	Fair.
24	18	72	80	29.19		1	W	Fair, a great dew.
	2	86	82	29.18		2	SSE	Fair.
Apr. 7	1	87	84	29.19		2	SE	Fair.
8	18	73	80	29.19		0	——	Fair.
	0	88	85	30.00		1	SE	Fair.
	10	80	83	30.00		1	E	Fair.
9	18	74	80	30.00		1	W	Fair.
	0	87	84	30.00		1	ESE	Fair.
	10	81	81	30.00		1	E	Fair.
10	18	73	79	29.19		0	——	Fair.
	5	83	83	29.18		1	E	Fair.
	10	80	82	29.19		1	ESE	Fair.
11	18	73	79	29.18		0	——	Fair.
	1	87	85	29.18		2	SSE	Fair.
	10	81	82	29.18		1	SW	Fair.
12	18	74	80	29.18		0	SE	Fair.
	10	81	83	29.18		2	SSE	Fair.
13	17	79	82	29.19		1	SW	Hazy.
	1	87	85	29.18		1	SE	Hazy.
	10	81	82	29.19		1	SSE	Fair.
14	17	76	81	30.00		1	W	A few clouds.
	2	87	85	29.19		2	SE	Fair.
	10	82	82	29.19		1	S	Cloudy.
15	17	78	82	29.18		1	N	Cloudy, beginning to rain.
	1	80	80	29.19	2.3	1	E	Cloudy, 1.14 of rain fell the firft 40'.
	11	78	79	29.19		1	SE	Cloudy.
16	17	74	79	29.18		0	——	A few clouds.
	0	86	81	30.00		1	ENE	Fair.
	10	79	80	29.19		1	ENE	Fair.
17	17	73	78	29.18		1	W	Fair.
	0	86	84	29.19		1	E	Fair.
	11	80	81	29.18		0	——	Fair.
18	17	79	79	29.18		0	——	Fair.
	1	87	84	29.17		1	E	Fair.
19	17	79	82	29.18		1	W	Fair.
	10	82	83	29.19		1	E	Fair.
20	17	79	82	29.19		0	——	Fair.
	0	80	84	29.19		1	SE	A few clouds; at 11 a gentle ſhower.

	Hour from Noon.	Therm. without	Therm. within	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches	In.			
Apr. 20	10	82	83	29.19		1	SE	A few hazy clouds.
21	17	79	83	29.19		1	——	A few clouds.
	2	87	85	30.00		2	E	Fair.
	11	82	83	30.00		1	S	A few clouds.
22	17	77	83	30.00		0	——	Fair.
	10	82	83	29.19		1	ESE	Hazy.
23	17	77	83	30.00		0	——	Fair.
	2	87	86	29.19		2	——	Fair.
	10	83	83	29.19		2	——	Fair.
24	17	76	81	29.19		1	W	Fair.
	10	82	83	29.19		2	SE	Fair.
25	17	76	82	29.19		0	——	Fair.
	1	87	85	29.19		2	SE	Fair.
	10	83	84	29.19		1	SE	Cloudy, black clouds N. with much lightning.
26	17	77	81	29.18		1	——	A few clouds.
	1	88	85	29.18		2	SE	Cloudy.
	10	82	83	29.18		2	S	A few clouds.
27	17	76	82	29.18		0	——	Fair.
	2	86	86	29.18		2	SSE	Fair.
	11	81	83	29.19		1	SSE	Fair.
28	17	77	82	29.18		0	——	Fair.
	1	87	85	29.18		2	SE by E	Cloudy.
	11	84	82	29.18		1	SW	Fair.
29	17	79	82	29.18		0	——	Fair.
	1	88	87	29.18		2	SE	The S.E. half of the hemisphere clear; the N.W. half black and threatening, with thunder and lightning.
	10	80	82	29.18		0	——	Cloudy.
May 1	1	94	89	29.18		1	WSW	Fair.
	11	84	85	29.18		2	S	Fair.
2	17	83	84	29.18		0	——	Cloudy.
	1	85	83	29.17	1.15	1	WSW	Cloudy, about forty minutes of exceeding hard rain, with almoſt inceſſant thunder.
	10	83	83	29.17		1	SSE	Fair, a pleaſant night.
3	18	81	82	29.17		1	SW	Fair.
	1	87	85	29.17		2	SE	Fair.
	10	84	84	29.18		1	S	Fair.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches.	In.			
May 4	17	80	82	29.17		1	S	Fair.
	1	89	85	29.·18		2	SSE	Fair.
	11	84	85	29.18·		·1	S	Dark threatening clouds to the Northward.
5	17	82	84	29 18		1·	S	Fair.
	3	87	86	29.17		2·	SE	Hazy.
	10	84	85	29.18		1·	S	Hazy.
6	17	80	82	29.18		1·	SW	Fair.
	11	83	85	29.19		3	SSE	Fair.
7	17½	81	83	29.19		1	SW	Fair.
	2	88	86	29 18		2·	SE	Fair.
	11	83	85	29.19		2	S	Fair.
8	18	80	83	29.18		1	SSW	Fair.
	11	84	84	29.19		2	S	Fair.
9	17	80	83	29.19		1	SSW	Fair.
	2	89	85	29.19		1·	ESE	Fair.
	10	85	85	29.19		1	ESE	Fair.
10	17	80	84	29.·19		·1	SW	Fair.
	2	90	86	29.·19		1·	ESE	Fair.
11	18	83	84	29.19		1	WSW	Fair.
	2	89	86	29.18		2	E	Fair.
	10	85	85	29.18		2	E	Fair.
12	17	82	84	29 18		0	——	Fair.
	0	89	86	29.19		2	ESE	Fair.
13	18	76	81	29.19	1.15	0	——	A dark, rainy morning, has rained most of the night.
	0	78	78	30.00		1	S	Cloudy, small rain most part of the forenoon.
14	18	79	80	29.·18	0.3	0	——	Fair.
	1	86	83	29.18		1	SE	A few light clouds.
	9	84	83	29.18		2	SE	Fair.
15	17½	78	81	29.18		1	SW	Fair.
	0	88	85	29.18		2	SE	Fair.
	10	85	84	29.18		2	SSE	Fair.
16	18	80	83	29.18		1·	SW	Fair.
	2	89	86	29.16·		2	SE	Fair.
	10	85	85	29.17		1	S	A few clouds.
17	17½	82	83	29.17		2	SW	Fair.
	2½	89	87	29.15		2·	SSE	Hazy.
	11	84	84	29.16		1	SSW	Hazy.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches.	In.			
May 18	2	89	86	29 15		2	E	Hazy.
	11	85	85	29.15		2	SSW	Hazy.
19	18	82	83	29.15		2	SW	Hazy.
	3	88	87	29.15		3	NE	Dark, cloudy, squally weather.
	11	80	82	29.16		1	S	Hazy, has rained hard a few miles to the S. W.
20	17	70	80	29.16		1	SW	A little haze.
	2	88	86	29.15		2	SE	Fair.
21	17½	80	82	29.15		1	W	A little hazy.
	1	89	86	29.15		1	E	Fair.
	11	85	85	29.16		2	S	Fair.
22	18	80	83	29.15		1	SW	Hazy.
	0	98	89	29.16		1	WSW	Hazy.
23	18	80	82	29.15		2	SSW	Hazy; yesterday the sea breeze came in at 1.
	0	97	88	29.15		1	WSW	Fair.
	11	85	85	29.16		2	SSW	Hazy; sea breeze came ½ past noon.
24	17½	80	81	29.15		2	SSW	Hazy.
	0	87	86	29.15		2	SE	Hazy.
	10	84	84	29.15		1	W	Cloudy, black threatening clouds to the Northward
25	21	83	82	29.15		1	W	Cloudy.
	2	87	85	29.15		2	SE	Cloudy.
	10	83	84	29.15		2	S	Cloudy.
26	17½	83	81	29.15		2	SW	Thick haze.
	1	102	86	29.15		1	W	Thick haze.
	0	83	84	29.15		2	S	Thick haze.
27	19½	85	83	29.16		2	SW	Fair.
	3	92	87	29.16		1	ENE	Fair.
	10	83	84	29.16		2	S	Fair.
28	18	82	82	29.15		2	SW	Fair.
	1	98	85	29.16		1	SW	Cloudy.
	10	84	84	29.16		2	S	Fair.
29	18	81	82	29.16		2	SW	Fair.
	0	100	88	29.16		1	W	Fair.
	11	83	84	29.16		2	S	Fair.
30	18	80	82	29.16		2	SW	Fair.
	1	88	86	29.16		2	SE	Fair.
	11	82	81	29.16		2	S	Fair.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777				Inches	In.			
May 31	18	81°	83°	29.16		1	SW	Fair.
	1	86	85	29.16		2	SE	Fair.
June 1	19	82	84	29.16		1	SW	Fair.
	11	83	84	29.17		1	S	Fair.
2	20	83	84	29.17		2	SSW	Fair.
	2	88	85	29.16		2	SE	Fair.
	10	84	84	29.16		2	S	Fair.
3	17½	81	84	29.16		1	SW	Fair.
	0	88	85	29.16		1	SE	Fair.
4	17½	83	84	29.16		1	S	Fair.
	10	84	83	29.16		1	S	Fair, much lightning to to the Westward.
5	18	80	83	29.16		1	SW	Fair.
	2½	98	87	29.16		1	SE	Fair.
	10	85	85	29.17		1	S	Fair, a few clouds to the Southward.
6	18	82	84	29.17		1	SW	Fair.
	0	88	85	29.17		2	SE	Fair.
	10	85	85	29.17		2	SSW	Fair.
7	10	84	85	29.17		2	SSE	Fair.
8	20	83	84	29.16		1	SW	Fair.
	2	88	86	29.15		2	SE	Fair.
	10	85	85	29.15		1	S	Fair.
9	18	84	84	29.15		1	W	Fair.
	1	88	—	29.15		1	E	Fair.
10	18	84	84	29.15		1	SW	Fair.
	3	90	83	29.15		2	SE	Fair.
11	18	84	84	29.15		1	W	Hazy.
	10	84	85	29.14		1	S	Thick haze.
12	18	85	85	29.14		2	W	Thick haze.
	3	93	87	29.14		1	NW	Cloudy.
	11	85	85	29.14		2	S	Cloudy.
13	2	90	88	29.14		1	W	Cloudy.
	10	81	84	29.16		1	N	Cloudy, has rained a few miles to the Northward.
14	18	81	81	29.15		2	W	Cloudy.
	3	93	85	29.15		2	W	Cloudy.
	10	86	85	29.16		1	W	Cloudy.
15	18	82	83	29.16		2	W	Cloudy.
	10	85	84	29.15		2	W	Cloudy.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches.	In.			
June 16	18	80	82	29.15		1	W	Cloudy.
	4	92	86	29.14		2	W	Cloudy.
	11	87	85	29.14		2	W	Cloudy.
17	18	80	82	29.14		2	W	Cloudy.
	2	96	87	29.14		2	W	Cloudy.
	10	86	86	29.14		1	SW	Cloudy.
18	18	82	84	29.16		1	W	Cloudy.
	2	98	89	29.16		2	W	Cloudy.
19	18	81	84	29.18		1	W	Cloudy, had a sea-breeze last night.
	10	83	85	29.17		2	S	Cloudy.
20	18	82	84	29.17		1	W	Cloudy.
	1	97	89	29.17		1	W	Hazy.
	11	84	87	29.17		0	——	Hazy.
21	3	98	90	29.15		2	WSW	Cloudy, had a gentle shower in the night.
	11	88	88	29.17		1	SW	Cloudy.
22	18	80	83	29.17		1	SW	Cloudy.
	3	95	89	29.16		2	SW	Cloudy.
	11	83	85	29.17		1	S	A little hazy.
23	3	92	89	29.16		2	SE	Hazy, sea-breeze just come in.
	11	84	86	29.17		2	S	A little hazy.
24	18	83	84	29.18		1	SW	A little hazy.
	3	88	88	29.16		2	SE	Fair.
25	2	100	92	29.16		1	W	Hazy.
	11	84	86	29.17		0	——	Cloudy.
26	18	83	84	29.17		1	W	Hazy.
	3	98	92	29.16		1	W	Hazy.
	10	82	86	29.16		2	S	Cloudy.
27	½	96	88	29.16		1	W	Cloudy.
	10	87	88	29.17		1	E	Cloudy.
28	18	81	84	29.17		1	W	Cloudy.
	3	93	90	29.16		1	E	Cloudy.
	10	82	84	29.18		2	S	Cloudy.
29	18	80	83	29.17		1	W	Cloudy.
	3	89	88	29.15		1	E	Fair.
	10	83	83	29.17		2	S	Cloudy.
30	18	79	82	29.16		1	W	Cloudy.
July 3	10	82	83	29.16		2	SW	Cloudy.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points	State of the Weather, &c.
1777		°	°	Inches.	In.			
July 4	18	78	81	29.16		0	SW	Cloudy.
	3	86	83	29.17		·1	SE	Cloudy.
	10	82	83	29.18		1	S	Cloudy.
5	18	77	79	29.17		1·	W	Cloudy.
	2	88	83	29.16		2	SE	Fair.
	10	83	84	29.18		2·	S	Fair.
6	2	88	83	29.16		2	SE	Fair.
	10	83	84	29.18		2·	S	Fair.
7	17	78	80	29.18		0	——	Fair.
	3	88	83	29.18		0	——	Cloudy, has rained hard to the Westward.
	10	80	82	29.18		1	W	Fair.
8	17	77	78	29.18		2	SW	Cloudy.
10	6	86	83	29.16		2	SE	Cloudy.
	12	80	83	29.16		1	W	Cloudy.
11	18	80	82	29.16		1	W	Cloudy.
	2	92	86	29.17		1	NW	Cloudy.
	11	81	83	29.18		2	S	Cloudy.
12	18	79	80	29.17		1	SW	Cloudy.
	10	75	79	29.·18		1	SW	Cloudy and hard rain,
13	18	75	78	29.17	1.0	1	W	Cloudy.
	10	78	79	29.18		1	W	Cloudy, rained last night.
14	17	77	78	29.17	0.8	1	W	Cloudy.
	2	92	83	29.16		2	W	Fair.
	11	81	82	29.18		1	W	Cloudy.
15	19	79	79	29.16		1	W	Cloudy.
	3	95	86	29.16·		2	W	Cloudy.
17	18	82	83	29.15		2	W	Cloudy.
	1	94	86	29.16		2	W	Cloudy.
18	18	81	83	29.15		1	W	Cloudy.
	3	92	85	29.·16		2	W	Cloudy.
	11	77	79	29.16		0	——	Cloudy, has rained hard.
19	18	78	79	29.15	1.0	1	W	Cloudy.
20	18	80	80	29 15		2	W	Cloudy.
	9	79	83	29.16	0 10	1	SW	Cloudy.
21	4	96	86	29.15·		2	W	Cloudy.
	10	84	84	29.16		1	S	Cloudy.
22	18	80	82	29 16·		1	W	Cloudy.
	1	97	85	29.16·		2·	W	Cloudy.
	11	85	85	29.17		1	S	Cloudy.

	Hour from Noon.	Therm. without	Therm. within.	Barom	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches	In.			
July 23	17	80	82	29.17		1	SW	Cloudy.
	10	81	83	29.17		3	S	Cloudy.
24	18	78	80	29.18	0.7	1	W	Cloudy.
	10	80	82	29.18		2	S	Cloudy.
25	17	78	80	29.18	0.8	1	W	Cloudy.
	3	97	86	29.17		2	W	Cloudy.
	10	80	82	29.18		2	SE	Cloudy.
26	17	78	80	29.17		1	W	Cloudy.
	1	94	84	29.18		2	W	Cloudy.
	4	86	84	29.17		2	SE	Cloudy.
	9	79	81	29.19		3	S	Cloudy.
27	18	78	80	29.17		1	W	Cloudy.
	2	95	86	29.18		2	W	Hazy.
	10	82	83	29.19		2	S	Fair.
28	18	80	80	29.19		1	W	Hazy.
	2	98	86	29.18		2	W	Hazy.
29	18	80	81	29.18		1	W	Hazy.
	1	99	86	29.19		2	W	Hazy.
	10	83	83	29.18		2	W	Hazy.
30	18	80	82	29.18		2	W	Hazy.
	2	99	90	29.18		2	W	Hazy.
	11	80	84	29.19		2	S	Hazy.
31	17	79	80	29.18	0.5	1	W	Cloudy.
	2	98	88	29.18		2	W	Cloudy.
	10	80	83	29.18		2	S	Fair.
Aug. 1	18	78	81	29.18	0.3	1	W	Cloudy.
	0	98	86	29.18		2	W	Hazy.
	11	79	82	29.19		1	SW	Hazy.
2	17	76	81	29.18	1.0	1	W	Cloudy.
	1	95	87	29.18		2	W	Fair.
	10	76	82	30.00		2	SW	Raining hard.
3	18	75	81	29.19	1.12	1	W	Hazy.
	1	90	86	29.18		1	W	Hazy.
	10	81	82	29.18		2	S	Hazy.
4	18	78	81	29.17		1	W	Hazy.
	0	89	84	29.18		2	W	Fair.
6	18	75	79	29.18	0.8	1	W	Fair.
Sept. 15	3	86	82	29.16		2	NW	Black, and threatening much rain.
16	20	80	77	29.19	1.0	0	——	Cloudy, with small rain.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777				Inches.	In.			
Sept. 24	8	82	82	29.18		2	S	Fair.
27	18	79	82	29.18		0	——	Fair.
	0	91	84	29.19		1	SW	Hazy.
	9	83	84	29.19		0	——	Hazy.
28	18	76	80	29.18	2.4	1	W	Cloudy, much thunder, lightning, and hard rain in the night.
	1	84	82	29.19		1	NW	Cloudy.
	9	78	79	29.18		0	——	Cloudy.
29	18	77	79	29.17	0.10	0	——	Cloudy.
	9	80	80	29.18		1	SW	Cloudy, lightning.
30	18	76	79	29.17		1	W	Cloudy.
	10	82	81	29.18		1	S	Fair.
Oct. 1	18	77	78	29.18		1	W	Fair.
	5	88	84	29.19		1	E	Fair.
	10	83	82	30.00		1	SE	Fair.
2	18	78	80	30.00		1	W	Fair.
	0	88	83	30.01		1	E	Fair.
3	18	79	81	30.00		0	——	Fair.
	1	88	84	30.00		1	E	A few clouds.
	10	82	83	30.00		1	NE	Fair.
4	18	78	80	30.00		0	——	Raining.
	0	84	83	30.00		1	NE	Fair.
	11	82	83	30.00		1	NE	Fair.
5	18	77	80	29.19	0.6	1	N	Cloudy, a great dew every night.
	0	85	82	29.19		1	NE	Fair.
	9	81	82	29.18		1	NE	Fair.
6	18	77	80	29.18		1	NW	Fair.
	0	87	83	29.18		1	NE	Fair.
	9	82	82	29.19		0	——	Fair.
7	18	78	79	29.17		0	——	Cloudy.
	1	87	84	29.17		1	NE	Cloudy.
	10	82	83	29.18		0	——	Cloudy.
8	18	79	79	29.16		1	W	Cloudy.
	2	82	83	29.16		0	——	Small rain.
	10	76	78	29.16		1	W	Small rain.
9	18	77	78	29.16	0.5	0	——	A few clouds.
	0	88	83	29.16		1	SE	Fair.
10	5	84	83	29.16	0.5	2	SE	Cloudy, rained in the night.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches.	In.			
Oct. 11	18	80	81	29.18		1	W	Cloudy.
	0	85	83	29.19		2	SE	Fair.
	9	82	82	29.19		2	SSE	Fair.
12	18	81	81	29.19		0	——	A few clouds.
	2	87	84	29.19		2	SE	Fair.
13	18	78	81	30.00		·1	W	Fair.
	1	86	84	30.01		1·	E	Cloudy.
	9	83	82	30.01		1	E	Cloudy.
14	18	78	80	30.00		·1	W	Cloudy.
	4	86	83	29.19		1	E	Fair.
15	18	78	80	29.19		0	——	Cloudy.
	11	81	82	30.01		1	E	Cloudy.
16	18	77	79	30.00	1.3	1	——	Fair, a hard ſhower in the night.
	3	85	83	30.00		2·	NE	Fair.
	11	80	82	30.01		1	NE	Cloudy, with flying ſhowers.
17	18	78	80	30.00	1.0	0	——	Cloudy, hard ſqualls in the night.
	10	81	81	30.01		1	E	Cloudy, ſhowers through the day.
18	18	77	80	30.00	1.16	0	——	Raining.
	7	82	80	29.19		1	E	Fair.
19	17½	78	80	30.00	0.4	0	——	Cloudy, thund. and lightn.
20	18	78	79	30.02		0	——	Fair.
21	3	86	84	29.18		2	NE	Fair.
22	18	78	80	29.18		0	——	A few clouds.
	1	79	80	29.18		·1	N	Cloudy, ſmall rain.
	11	77	79	29.18		·1	N	Raining.
23	18	76	78	29.18	0.12	1	W	Cloudy.
	9	80	81	29.18		1	S	Cloudy.
24	18	78	78	29.17		1	S	Fair.
	10	83	82	29.18		0	——	A few clouds.
25	18	80	80	29.18		1	SW	Fair.
26	10	83	83	29.19		2	E	Fair.
27	18	80	80	29.19		0	——	Fair.
	0	85	84	30.00		1	E	Fair.
28	18	79	80	30.00		1	NW	Fair, BAIRD's Maine bar. 29⅛.
29	9	81	80	30.01		2	E	Fair.
30	18	76	78	30.00	0.6	·1	NW	Cloudy.
	1	85	81	30.00		1	NE	Fair.
	10	80	81	30.00		2	N	Cloudy.
31	18	79	80	30.00		·1	NW	Cloudy.
	3	85	82	30.00		·1	E	Cloudy.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches.	In.			
Nov. 1	18	74	78	30.00		0	——	Cloudy.
	3	82	80	30.00		2	N	Cloudy.
	9	76	79	30.00		2	N	Cloudy.
3	18	70	75	30.00		1·	N	Fair.
	2	85	81	30.00		·2	NNE	Fair.
	10	76	79	30.00		1·	N	Fair.
4	18	68	75	30.00		·1	NW	Fair, much dew.
	2	85	81	30.00		1·	NNE	Hazy.
5	18	72	75	30.00		1	NW	Fair.
	2	85	80	30.00		3	N	Fair.
6	18	75	79	30.00	0.2	0	——	Cloudy.
	2	76	78	29.19		1·	N	Cloudy, a little ſmall rain.
	10	78	78	30.00		1	N	Cloudy.
7	2	84	80	29.19		1	NE	Cloudy.
	10	77	79	30.00		0	——	Hazy.
8	18	75	77	30.00		1	NW	Cloudy.
	2	85	81	29.19		1·	E	Fair.
9	18	76	79	30.00		1	NW	Cloudy, a little ſmall rain.
	1	83	80	29.19		2	NNE	Light flying ſhowers.
10	18	78	79	29.19	0.3	1	N	Cloudy.
	0	85	83	30.00		2	NNE	Fair.
11	18	76	79	30.00		1	NW	Fair.
	10	79	81	30.00		1	NE	Hazy.
12	18	76	79	30.00		1	NW	Hazy.
	2	85	82	29.19		3	NNW	Hazy.
13	20	75	76	30.00		2	N	Cloudy.
	8	77	79	30.00		1	NNW	Cloudy.
14	17	70	74	29.18		1	NW	Cloudy.
	2	71	74	29.17		1	N	Dark clouds, with thunder and lightning.
	10	69	73	29.18		2	N	Dark clouds, with thunder and lightning, with rain.
15	19	65	72	29.17	1.9	2	WNW	Cloudy, raining.
	0	72	74	29.17		3	N	Cloudy.
	10	70	73	29.18		2	NW	Cloudy, frequent ſhowers.
16	19	72	72	29.18	1.0	2	NW	Cloudy, frequent ſhowers.
	1	81	78	29.19		2	N	Fair.
	9	78	78	29.19		2	NE	Cloudy.
17	20	78	77	29.19		1	NW	Cloudy.
	2	80	78	29.19		2	NE	Cloudy, rained in the forenoon.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches.	In.			
Nov. 18	19	72	75	29.19	0.14	1	NW	Fair.
	2	81	78	29.19		2	NE	Fair.
	10	76	76	30.00		1	N	Fair.
19	18	72	73	30.00		1	NW	Fair, some dew on the grass.
20	18	67	73	30.01		1	NW	Fair, a great dew.
	1	81	78	30.01		2	N	Fair.
	10	73	75	30.02		1	N	Fair.
21	18	66	72	30.02		1	NW	Fair, a great dew.
	0	81	77	30.03		2	NNE	Fair.
	11	75	75	30.04		2	NNE	Fair, NAIRNE's marine bar. $29^{0}\frac{8}{10}$.
22	18	70	73	30.03		1	W	Fair, low black clouds to Westward.
	3	81	78	30.02		2	NE	Fair.
	10	75	75	30.03		3	N	Fair.
23	18	71	75	30.02		1	NW	Fair.
	0	81	78	30.02		3	N	Fair.
	10	77	77	30.02		2	N	Fair.
24	18	73	76	30.01		1	N	Fair.
25	18	70	74	30.00	2.10	2	N	Much rain and wind through the night.
	10	77	77	30.01		1	N	Cloudy.
26	18	75	75	29.19	1.0	2	NNE	Cloudy.
	0	77	76	30.01		2	NNE	Cloudy.
	10	77	75	30.01		2	N	Cloudy.
27	18	74	75	30.00		1	N	Cloudy.
	3	80	76	30.00		2	NNE	Fair.
	10	76	75	30.00		1	N	Fair.
28	18	73	74	30.00		1	NW	Cloudy.
	10	75	76	30.01		2	N	Fair.
29	18	70	74	30.00		1	NW	Fair.
	10	75	75	30.02		1	N	Fair.
30	8	69	74	30.02		1	NW	Fair, dew on the grass.
	1	83	79	30.02		2	NE	Fair.
	10	76	76	30.03		2	N	Cloudy.
Dec. 1	18	75	75	30.02		1	NW	Cloudy.
	23	82	78	30.03		2	NNE	Fair, NAIRNE's marine bar. $29^{0}\frac{9}{10}$.
	10	77	78	30.02		2	N	Fair, NAIRNE's marine bar. $29^{0}\frac{8}{10}$.
2	18	71	75	30.02		1	NW	Fair.
	2	82	78	30.01		2	NNE	Cloudy.
	10	77	77	30.01		1	NNE	Fair.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	Inches	in.			
Dec. 3	18	70	74	30.0·1		1	NW	Fair, dew
	2	86	78	30.01		·3	NE	Fair.
	11	73	75	30.02		1	N	Fair.
4	18	68	73	30.01		·1	NW	Fair, dew.
	10	75	76	30.02		·1	N	Fair.
5	18	69	73	30.01		1	NW	Fair, dew.
	0	82	78	30.02		2	NE	Fair.
6	18	70	75	30.01		1	NW	Fair, dew.
7	18	70	74	30.02		1	NW	Fair, dew.
	10	75	77	30.02		2	N	Fair.
8	1	82	79	30.02		3	NNE	A few clouds.
9	18	74	76	30.02		2	NNE	Fair.
	4	80	79	30.02		3	NE	Fair, no dew.
10	18	73	74	30.02		2	NE	Cloudy.
	0	83	77	30.03		3	NE	Fair.
11	18	70	—	30.02	0·2	1	NNW	Cloudy.
12	18	69	72	30.00		2	N	Raining.
	0	71	74	30.01		2	NNE	Rain just over.
	10	75	76	30.00		2	N	Frequent showers.
13	18	74	76	29.19	2·2	3	NE	Raining.
	0	80	76	30.01		2	NE	A few clouds.
	10	74	76	30.02		2	N	A few clouds.
14	18	74	75	30.01	0·19	2	NNE	A few clouds.
	1	81	78	30.01		3	NNE	A few clouds, WATSON's mar. b. 29° 7 10
	10	76	76	30.02		2	N	A few clouds.
15	12	70	74	30.02		1	N	Fair.
16	18	68	74	30.02		0	——	Fair, much dew.
	12	70	74	30.02		1	N	Fair.
19	23	81	78	30.04		2	NE	Fair.
20	18	74	75	30.02		1	N	Fair.
	23	80	78	30.03		2	NNE	Fair.
	11	76	77	30.03		2	NNE	Fair.
21	18	74	75	30.02		1	NNE	Cloudy.
	0	81	77	30.04		3	NNE	Cloudy.
	10	74	76	30·04		1	N	Cloudy.
22	18	73	—	30.03		1	N	Cloudy.
	10	73	75	30.03		1	N	Fair.
23	18	60	—	30.04		1	NW	Fair, some dew.
	11	75	75	30.03		3	NNE	A few clouds.

	Hour from Noon.	Therm. without	Therm. within	Barom.	Rain. Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1777		°	°	nches.	In.			
Dec. 24	18	73	—	30.02		1	NW	Cloudy.
	10	76	76	30.01		2	N	A few clouds.
25	18	76	76	30.0·1	0·4	2	NE	Cloudy and threatens rain.
	10	76	76	30.0·2		2	N	Fair.
26	4	72	76	30.01		1	N	Small rain.
	10	72	75	30.01		1	N	Cloudy.
27	0	80	77	30.01		2	N	Cloudy.
28	18	73	74	30.00		1	N	Fair.
	23½	81	78	30.01		3	NNE	Cloudy.
	9	75	75	30.00		2	N	Fair.
29	18	67	74	30.00		1	NW	Fair, dew.
	2	79	77	30.01		2	NE	
30	18	69	—	30.01		1	NNW	Cloudy.
	11	72	75	30.01		1	N	A few clouds.
31	18	71	74	30.01		1	NW	A few clouds.
1778								
Jan. 1	18	67	74	30.01		1	NW	Fair.
2	18	69	73	30.01		1	NW	Fair.
	1	81	76	30.02		2	NE	Fair.
3	8	75	76	30.02		1	NE	Fair.
4	18	74	—	30.02		1	NE	Cloudy.
5	18	68	74	30.01		1	NW	Cloudy.
	1	80	77	30.02		3	NE	Cloudy.
	10	74	75	30.02		1	N	Fair.
7	0	79	76	30.01		2	NE	Fair.
	10	72	75	30.02		1	N	Fair.
8	18	68	74	30.02		1	NW	Fair.
9	18	67	73	30.01		1	NW	Hazy.
	0	78	76	30.01		1	NE	Hazy.
	10	73	74	30.01		2	NE	Fair.
10	18	69	74	30.01		1	N	Fair.
13	18	66	71	30.00		1	NW	Fair, a great dew.
14	18	64	70	30.00		0	——	Fair, a great dew.
	23	77	75	30.01		1	NE	Fair.
15	19	65	70	30.00		0	——	Fair, a great dew.
	11	74	74	30.01		1	N	Fair.
16	18	66	71	30.0·1		1	NW	A few clouds.
	1	79	76	30.0·1		1	NE	Fair.
17	18	65	71	30.00		1	NW	A little foggy.
	10	75	75	30.01		1	NE	Fair.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1778		°	°	Inches.	In.			
Jan. 18	18	69	73	30.02		1	NW	Fair, a little dew.
	23	80	77	30.03		·1	ESE	Fair.
	10	76	76	30.02		1	ESE	Fair.
19	18	67	74	30.02		1	NW	Fair.
	9	73	76	30.03		1	NE	Fair.
20	18	69	74	30.02		1	N	Fair.
	10	75	75	30.0·4		1·	N	Fair.
21	18	68	73	30.03		1	NW	Fair.
	2	80	78	30.03		2	NE	Fair.
22	18	67	71	30.02		0	——	Fair.
	2	80	77	30.02		2	ENE	Fair.
23	18	67	72	30.02		1	NW	Fair.
	10	74	75	30.02		1	ENE	Fair.
24	18	66	71	30.00		1	NW	Fair.
	1	82	77	30.01		1	NE	Hazy.
25	18	68	72	30.0·1		·1	NW	Fair.
31	18	69	74	30.01		·1	NW	Fair.
	½	82	78	30.02		2·	ENE	Fair.
Feb. 2	18	69	73	30.02		1	NW	Fair.
	4	80	78	30.02		3	NNE	Fair.
3	18	76	76	30.02		2	NNE	Cloudy.
5	18	65	71	30.00		·1	NW	Fair, dew.
	10	74	77	30.0·1		1	ENE	Fair.
6	18	65	70	30.00		0	——	Fair, dew.
7	21	79	76	30.02·		·1	SE	Fair.
	10	76	77	30.01·		·1	SE	Fair.
8	19	66	71	30.0·1		0	——	Fair.
	2	80	76	30.0·2		1·	ESE	Fair.
	10	75	75	30.02·		1	E	Fair.
9	18	68	73	30.0·2		1	W	Fair.
10	18	68	72	30.02		1	W	Fair.
11	2	82	79	30.02		1·	NNE	Fair.
	10	75	78	30.02		1·	NNE	Fair.
12	18	71	75	30.0·2		1·	NW	Fair.
	3	81	78	30.01·		2·	NNE	Fair.
	10	75	77	30.01		1	NE	Fair.
13	18	67	72	30.01		1	NW	Fair.
	10	75	77	30.02		0	——	Fair.

	Hour from Noon.	Therm. without	Therm. within.	Barom	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1778		°	°	nches	In.			
Feb. 14	18	69	74	30.01		1	NW	Fair.
	2	81	78	30.01		·2	NE	Fair.
	11	74	76	30.02		·1	NE	Fair.
15	18	67	72	30.01·		1	NW	Fair.
	3	81	79	30.01		2	NE	Fair.
	10	76·	76	30.01·		2	N	Fair.
16	18	70	75	30.01		1	NW	Cloudy.
	10	74	76	30.02		0	——	Fair.
17	18	67	71	30.01		1	NW	Fair.
	4	81	78	30.01		2	E	Fair.
18	18	70	73	30.02		1	W	Cloudy.
	3	81	79	30.02		1·	E	Fair.
	10	79	76	30.02·		1·	E	Fair.
19	18	77	78	30.02·		2	E	Fair.
	9	79	79	30.0·4		2	NE	Cloudy.
20	0	84	80	30.0·3		2	ESE	Fair.
22	18	72	78	30.02		0	——	Hazy.
23	18	73	78	30.02		0	——	Fair.
24	18	71	70	30.01		0	——	Fair.
	23	84	80	30.03		1	NE	Fair.
	9	77	78	30.02		1	NE	Fair.
25	18	69	75	30.01·		·1	W	Fair, much dew.
	2	86	79	30.0·1		1	E	Fair.
26	18	68	74	30.01		1	W	Fair.
27	18	68	74	30.01		0	——	Fair.
	0	81	78	30.0·1		2	SE	Fair.
	11	77	78	30.01		1	SE	Fair.
Mar. 1	3	82	79	30.00		3	SE	Fair.
	11	78	78	30.01		2	SSE	Fair.
2	18	77	76	30.00		·1	W	Fair.
	10	80	80	30.00		2	S	Fair.
4	10	80	80	30.00		2	SE	Fair.
5	18	74	78	30.00		0	——	Fair.
	10	78	78	30.00		2	E	Fair.
6	18	72	75	30.00		·1	W	Fair.
	0	83	80	30.00		1	E	Fair.
8	10	77	78	30.02		1	E	Fair.
9	18	70	74	30.02·		·1	W	Fair.
	0	81	79	30.02		1·	E	Fair.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1778		°	°	inches.	In.			
Mar. 10	18	70	75	30.01		0	——	Fair.
	11	79	78	30.01		1	E	Fair.
11	18	69	75	30.01		1	W	Fair.
	3	83	80	30.00		2	E	Fair.
	10	80	79	30.00		2	ESE.	Fair.
12	10	79	79	30.00		2	ESE	Fair.
14	18	76	79	30.00		0	——	Fair.
17	1	84	81	30.01		2	SE	Fair.
	10	80	80	30.01		1	E	Fair.
18	18	73	78	30.01		0	——	Fair.
	3	85	81	29.19		2	SE	Fair.
	10	80	80	30.00		2	SE	Fair.
19	18	74	78	29.19		1	W	Fair.
	0	84	80	30.00		1	E	Fair.
	10	80	80	29.19		2	S	Fair.
20	18	73	78	29.19		1	W	Fair.
	2	85	81	29.19		3	SE	Fair.
21	18	76	78	29.19		1	W	Fair.
23	10	79	81	29.18		2	SE	Fair.
24	2	87	83	29.17		3	S	Fair.
	10	81	81	29.18		2	S	Fair.
25	18	80	81	29.19		1	SW	Fair.
	0	89	84	29.19		3	S	Fair.
	10	81	81	29.18		2	S	Fair.
26	18	79	80	29.19		2	S	Fair.
	3	88	84	29.18		2	S	Fair.
27	18	78	80	29.19		2	S	Fair.
28	19	81	82	30.01		1	SE	Fair.
29	18	76	79	30.01		0	——	Fair.
	0	86	83	30.01		2	SE	Fair.
	10	81	80	30.01		1	SE	Fair.
30	18	78	80	30.01		0	——	Fair.
	10	81	82	30.01		2	SE	Fair.
31	18	76	80	30.01		0	——	Fair.
	3	86	82	30.01		1	E	Fair.
	10	80	80	30.01		1	SE	Fair.
Apr. 1	18	74	78	30.00		0	——	Fair.
	2	84	82	30.00		2	E	Fair.
2	18	74	77	30.00		0	——	A few light clouds.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points.	State of the Weather, &c.
1778		°	°	Inches.	In.			
Apr. 3	18	73	77	30.00		0	——	Fair.
	6	83	82	30.00		2	SE	Fair.
4	23	78	81	30.02		2	E	Fair.
6	21	86	81	30.02		1	S	Fair.
9	23	86	82	30.01		2	SE	Fair.
10	17½	73	77	30.00		0	——	Fair, a great dew.
	2	88	83	29.19		3	S	Fair.
11	20	85	82	30.00		3	S	Fair, a great dew.
	23	94	84	30.0·1		1	SW	Fair, very hot.
12	8	83	83	30.00		1·	SSE	Fair.
14	18	81	79	30.00		1	W	Fair.
16	18	80	79	29.18		2	S	Fair, a strong southerly wind all night.
	10	82	82	29.19		2	SE	Fair.
17	0	89	84	30.00		3	S	Fair.
18	12	81	82	30.02		1	S	Fair.
19	17½	76	80	30.02		0	——	Foggy.
20	20	85	81	30.01		1	SW	Fair.
21	21½	85	81	30.00		2	SSE	Fair.
22	21	86	82	30.00		1	S	Fair.
	5	86	84	29.19		1	E	Fair.
23	17	82	81	30.00		1	E	Fair.
	23	88	83	30.01		1	NE	Fair, had a very gentle shower at 9.
24	17	82	81	30.00		1·	E	Cloudy round the horizon.
	0	86	83	30.00		3	SE	Cloudy round the horizon.
25	17	78	80	30.00		0		Hazy.
	7	84	83	29.19		2	SE	Clouds to the Westward, with much lightning.
26	22	89	84	30.00		2	SSE	Fair.
	11	83	83	29.18		2	S	Fair, lightning to the Westward.
27	17	81	82	29.17		1·	SW	Fair.
28	17	82	83	29.16		2	S	Cloudy.
29	21	87	84	29.19		2	S	Fair, has been little dew these ten days past.
30	19	82	83	29.19		1	S	Fair.
	8	82	83	29.19		1·	SE	Fair.
May 1	17½	77	80	29.19		0	——	Fair.
2	21½	90	84	29.19		2·	SSW	Fair.
	6	85	84	29.19		1·	SE	Fair.
3	17	80	84	29.18		1	SSW	Fair.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds. Str.	Winds. Points	State of the Weather, &c.
1778		°	°	Inches.	In.			
May 3	7	84	84	29.17		1	S	Cloudy, has been squally, with thunder and lightning to the Westward.
5	17½	82	82	29.18		1	S	Fair.
	23	89	84	29.19		2	SE	Dark black clouds to the N.W.
7	17	80	80	29.17		·1	SW	Fair.
8	20	87	84	29.18		·1	SW	Fair.
	4	89	85	29.16		1·	SSE	Fair, clouds to the Westw.
	11	83	85	29.18		·1	S	Cloudy.
9	17½	80	81	29.17		0		Cloudy.
10	22	89	84	29.19		1	SE	Fair.
	10	84	84	29.17		1	SE	Fair.
11	0	82	83	29.17		1	S	Fair.
12	1	88	85	29.18		2	SE	Fair.
13	1	88	85	29.18		2	SE	Fair.
	10	83	84	29.18		2·	S	Fair.
14	17½	82	83	29.18		1	SW	Fair.
	2	88	85	29.18		2	SSE	Fair.
15	22	88	85	29.19		1	SE	Fair.
16	19	85	83	29.18		0		Fair.
17	18	81	83	29.18		0	W	Fair.
	23	100	89	29.18		1	W	Fair, first day of the land wind.
	6	88	86	29.16		2	SW	Cloudy, flying showers to the Westw.
18	17½	82	83	29.17		1·	W	Fair.
	0	104	90	29.18		1	W	Fair, exceeding hot.
	1	90	89	29.18		2	SE	Cloudy, sea breeze came in half an hour ago.
19	20	90	84	29.18		1·	SW	Cloudy.
	0	100	89	29.19		·1	W	Cloudy, sea breeze in sight.
	¼	90	88	29.18		2·	SE	Cloudy, a fresh sea breeze.
	7	84	84	29.17		1	S	Cloudy, thunder in the afternoon, much lightning.
20	17½	80	83	29.18		1	W	Fair.
	0	93	88	29.19		1	E	Fair, sea breeze just come in.
	10½	84	83	29.18		3	S	Fair.
21	21	93	80	29.18		·1	S	Fair.
	6	85	85	29.16		2·	SSE	Fair, a strong S.W. wind all day.
22	19	82	83	29.17		0		Fair.
	0	100	89	29.18		0		Fair, sea breeze coming in.

	Hour from Noon.	Therm. without	Therm. within.	Barom.	Rain Gage.	Winds, Str.	Winds, Points.	State of the Weather, &c.
1778		°	°	Inches.	In.			
May 23	20	90	85	29.18		2	W.	Fair.
	3	88	85	29.16		1	E	Cloudy.
	12	84	85	29.18		0		Cloudy.
25	0	99	89	29.17		2	S	Fair.
	12	84	84	29.16		·1	W	Cloudy.
26	0	104	90	29.16		·1	W	Hazy.
27	18	81	82	29.15		1·	W	Cloudy.
	1	101	90	29.16		0		Cloudy.
28	18	82	83	2 .15		1	SW	Fair.
	1	101	90	29.17		0		Fair, thermometer in the ⊙ 133°.
29	21	86	83	29.18		·1	NE	Cloudy.
	4	101	89	29.16		1	W	Fair.
30	17½	84	84	29.16		2	W	Fair.
	12	85	86	29.15		2	S	Fair, sea-breeze came in at 1.
31	0	100	90	29.17		2	ENE	Fair, just come in.

A table of the greateſt, leaſt, and mean heights of the thermometer [a] and barometer in each month, from March 1777 to May 1778.

Month.	Thermometer			Barometer		
	Greateſt Height.	Leaſt Height.	Mean Height.	Greateſt Height.	Leaſt Height.	Mean Height.
	°	°	°	Inches.	Inches	Inches.
March	87	67	77	30.03	29.18	30.00½
April	88	73	80½	30.00	29.17	29.18½
May	102	76	88½	30.00	29.15	29.17½
June	100	79	89½	29.18	29.14	29.16
July	99	75	87	29.19	29.15	29.17
Auguſt	98	75	86½	30.00	29.17	29.18½
September	91	76	83½	29.19	29.16	29.17½
October	88	76	82	30.02	29.16	29.19
November	85	65	75	30.04	29.17	30.00½
December	87	66	76½	30.04	29.19	30.01½
1778 January	82	64	73	30.04	30.00	30.02
February	86	65	76½	30.04	30.00	30.02
March	89	69	79	30.02	29.17	30.00½
April	94	73	83½	30.02	29.16	29.19
May	104	77	90½	29.19	29.15	29.17

(a) The thermometer without doors is meant.

A table

A table of the number of European patients admitted into, discharged from, and who died in, Fort St. George Hospital; also an account of the different diseases, taken at the end of each month, during part of the year 1777.

Diseases.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1. Continued fevers,	12	13					15	9	6	4
2. Intermitting fevers,	2	0					1	0	1	1
3. Hepatitis; here it is commonly called the liver,	9	14					10	7	4	3
4. Liver cough,	8	3					4	4	1	3
5. Liver flux,	11	8					11	11	7	8
6. Bilious, where there are no evident obstructions and little fever,	9	12					7	6	6	6
7. Fever and flux,	0	5					0	2	2	0
8. Diarrhæa and dysenteria,	20	19					18	23	43	34
9. Rheumatism, old venereal pains, &c.	24	20					28	33	31	30
10. Abdominal obstructions, with little or no fever,	12	10					19	13	7	10
11. Phthisis pulmonalis,	1	1					2	1	0	1
12. Coughs and colds,	6	5					4	9	8	7
13. Epilepsy,	1	2					3	0	1	0
14. Nervous,	2	2					2	3	2	2
15. Dropsy,	1	2					2	3	1	1
16. Jaundice,	0	0					0	0	0	0
17. Itch,	2	0					3	0	1	2
18. Gravel,	7	5					4	5	2	1
19. Diabetes,	1	3					1	0	0	1
20. Strangury,	0	0					4	2	3	4
21. Diseases of the eyes,	4	3					0	0	0	0
22. Venereal,	48	44					37	43	37	40
23. Piles,	3	2					2	3	1	1
24. Fistula,	1	1					0	0	0	0
25. Rupture,	0	1					0	0	0	0
26. Surgical, mostly old ulcers,	17	18					22	16	15	16
27. Anomalous,	6	4					11	8	4	4
28. Accidents,	3	6					10	2	3	1
Received into the hospital,	116	110	146	141	119	121	111	104	84	109
Discharged cured,	96	121	123	147	122	93	111	103	84	74
Deaths,	2	2	3	6	7	2	3	5	8	8
Remains,	210	203					220	203	186	180

A table

A table of the number of European patients admitted into, discharged from, and who died in, Fort St. George Hospital; also an account of the different diseases, taken at the end of each month, during part of the year 1778.

Diseases.	Jan.	Feb.	Mar.	Apr.	May
1. Continued fevers,	6	9	7	10	18
2. Intermitting fevers,	0	0	1	0	0
3. Hepatitis; here it is commonly called the liver,	7	6	7	8	3
4. Liver cough,	6	2	1	3	3
5. Liver flux,	6	6	6	14	7
6. Bilious where there are no evident obstructions and little fevers,	4	4	11	7	6
7. Fever and flux,	0	0	3	3	4
8. Diarrhœa and dysenteria,	24	25	34	27	40
9. Rheumatism, old venereal pains, &c.	26	17	16	28	29
10. Abdominal obstructions, with little or no fever,	9	13	8	13	8
11. Phthisis pulmonalis,	1	0	2	1	0
12. Coughs and colds,	5	7	8	9	6
13. Epilepsy,	0	0	1	1	0
14. Nervous,	3	6	4	1	1
15. Dropsy,	1	1	0	0	0
16. Jaundice,	1	1	0	0	0
17. Itch,	2	1	1	2	1
18. Gravel,	1	1	1	0	1
19. Diabetes,	0	0	1	1	1
20. Strangury,	3	5	4	1	4
21. Diseases of the eyes,	1	0	0	3	2
22. Venereal,	43	34	37	45	31
23. Piles,	0	1	1	0	0
24. Fistula,	0	1	1	0	0
25. Rupture,	0	1	1	1	1
26. Surgical, mostly old ulcers,	18	11	7	14	13
27. Anomalous,	6	6	3	9	8
28. Accidents,	3	4	3	6	10
Received into the hospital,	125	113	63	94	85
Discharged cured,	74	77	85	119	110
Deaths,	5	5	2	3	4
Remains,	170	162	170	207	197

You

You will find the numbers remaining in the hoſpital do not agree with the number received, diſcharged, and deceaſed, becauſe it frequently happens, that patients are received and diſcharged between the beginning and end of the month, of courſe cannot come into the number remaining at the end of the month.

The number received and diſcharged are taken from the hoſpital books, kept by a clerk.

XV. *A Journal of the Weather at* Montreal. *By Mr.* Barr, *Purveyor to his Majeſty's Hoſpitals in* Canada; *communicated by Dr.* Saunders.

Read January 20, 1780.

THE winter ſeemed to ſet in about the middle of November; from that time to the end of the month we had ſome ſnow and cold weather; but the thermometer never was lower than 16° or 18° below the freezing point.

About the 24th and 25th of December people croſſed the river three miles below Montreal.

The letters a and b after the figures denote the mercury to be above or below 0. The thermometer from which theſe obſervations were taken, was of FAHRENHEIT's conſtruction; it was ſuſpended to a poſt, perfectly in the ſhade, and no building nearer to it to reflect the heat than five or ſix feet.

FOR DECEMBER, 1778.

Day.	Thermometer. Morning	Thermometer. Evening	Snow.	Rain.	Winds.	Remarks.
	°	°	Inch.			
1	24 a o	28 a o	4		SW	A great fall of ſnow laſt night.
2	31 a o	28 a o			W	Some ſnow this afternoon.
3	11 a o	19 a o			NW	Cloudy.
4	27 a o	30 a o			W	Cloudy with a little ſnow.
5	33 a o	33 a o		Rain.	W	Cloudy.
6	29 a o	18 a o			E	Cloudy.
7	o	6 a o			E	Cloudy.
8	14 a o	8 a o	6		E	Cloudy, it ſnowed all day.
9	4 b o	2 a o			NW	Clear.
10	4 a o	16 a o			NE	Cloudy, with a little ſnow.
11	9 a o	7 a o			E	Cloudy.
12	4 b o	7 a o			NE	Clear.
13	14 a o	20 a o	12		NE	Cloudy, the wind high with a great drift.
14	16 a o	o			W	Cloudy.
15	6 b o	7 a o			SW	Cloudy.
16	1 a o	12 a o			NW	Clear.
17	32 a o	33 a o		Rain.	Calm.	Cloudy, and a thick fog and rain.
18	32 a o	25 a o			SW	Cloudy.
19	12 a o	16 a o			NE	Cloudy.
20	19 a o	32 a o		Rain.	NE	Cloudy, the wind S. in the evening.
21	16 a o	15 a o			E	Cloudy.
22	7 b o	4 b o			NW	Clear, and very little wind.
23	12 b o	6 b o			W	Clear, and very little wind.
24	14 b o	12 b o			NW	Clear.
25	21 b o	18 b o			NE	Clear.
26	8 b o	3 b o			NE	Cloudy, with ſome ſnow.
27	9 b o	1 b o			N	Clear.
28	5 b o	4 a o			W	Clear.
29	8 a o	21 a o			N	Clear.
30	31 a o	21 a o			W	Clear.
31	18 a o	32 a o			W	Clear.

FOR JANUARY, 1779.

Day.	Thermometer. Morning	Thermometer. Evening	Snow.	Rain.	Winds.	Remarks.
	°	°	Inch.			
1	33 a o	29 a o			W	Clear.
2	22 a o	32 a o		Rain.	NW	Clear.
3	37 a o	14 a o			SW	Clear.
4	6 a o	14 a o			NW	Clear.
5	11 a o	20 a o			W	Clear.
6	16 a o	7 a o			W	Cloudy.
7	2 a o	7 a o			NE	Cloudy.
8	3 a o	6 a o			N	Clear.
9	4 a o	29 a o			NE	Cloudy, with a little snow.
10	36 a o	8 a o		Rain.	SW	Cloudy, in the morning rain.
11	12 b o	7 b o			NW	Clear.
12	5 a o	18 a o			SW	Cloudy, with some snow.
13	16 a o	20 a o			W	Clear.
14	14 a o	18 a o			W	Clear.
15	10 a o	21 a o			NW	Clear.
16	3 a o	6 a o			NW	Clear.
17	5 a o	7 a o	4		NE	Cloudy, with snow all day.
18	11 b o	7 b o			NW	Clear.
*19	22 b o	12 a o			NE	Cloudy, with some snow.
20	15 a o	8 a o			W	Clear.
21	4 a o	7 a o			W	Clear.
22	8 b o	18 a o	2		NW	Clear, and almost calm.
23	12 a o	12 a o	4		NE	Cloudy, with snow.
24	10 a o	16 a o	4		NE	Cloudy, with snow.
25	17 a o	25 a o	6		NE	Cloudy, a great fall last night.
26	25 a o	12 a o			N by W	Cloudy.
†27	o	6 a o			NE	Clear.
28	20 a o	22 a o			W by S	Cloudy, with some snow.
29	5 a o	11 a o			NE	Cloudy.
30	4 b o	23 a o	4		N by W	Clear, but snow in the evening.
31	22 a o	26 a o			W	Cloudy.

* This day 16 or 17 German soldiers were frozen to death in crossing the ice on the Lake St. Pierre, a lake near Trois Rivieres; and about double the number were frost bitten, many of whom lost their feet and hands.

† Uncommon to have the weather clear when the wind is easterly.

FOR

FOR FEBRUARY, 1779.

Days.	Thermometer. Morning	Thermometer. Evening	Snow.	Rain.	Winds.	Remarks.
	°	°	Inch.			
1	33 a o	34 a o			W by E	Cloudy.
2	40 a o	45 a o		Rain.	SW	Cloudy, with a thick fog.
3	30 a o	26 a o			NE	Cloudy.
4	28 a o	27 a o			SW	Cloudy, with a little snow.
5	7 a o	10 a o			W by N	Clear.
6	1 a o	15 a o			N by E	Clear.
7	14 a o	29 a o	4		NE	Cloudy, with snow.
8	5 a o	8 a o			NE	Clear.
9	11 a o	23 a o	4		NE	Cloudy, with snow last night.
10	24 a o	35 a o			Calm	Foggy.
11	21 a o	16 a o			W	Clear.
12	13 a o	37 a o			W by S	Clear.
13	30 a o	31 a o			W	Clear.
14	20 a o	25 a o	2		NE	Cloudy, with snow.
15	23 a o	24 a o			NE	Cloudy.
16	14 a o	24 a o			NE	Cloudy.
17	22 a o	38 a o			NE	Cloudy, and the wind high.
18	27 a o	27 a o			W	Clear.
19	34 a o	36 a o			W	Cloudy.
20	34 a o	19 a o			W	Cloudy.
21	9 a o	35 a o			N by E	Cloudy, the wind S. at night.
22	38 a o	39 a o			SW	Cloudy.
23	31 a o	32 a o		Rain.	W by N	Clear.
24	14 a o	20 a o			N	Clear.
25	19 a o	22 a o			W by N	Cloudy.
26	19 a o	34 a o	4		W	Cloudy, with snow all day.
27	26 a o	31 a o			E	Cloudy.
28	31 a o	39 a o		Rain.	NE	Cloudy, with a fog and rain.

FOR MARCH, 1779.

Days.	Thermometer. Morning	Thermometer. Evening	Snow.	Rain.	Winds.	Remarks.
	°	°	Inch.			
1	28 2 0	28 2 0			N by E	Clear.
2	21 2 0	38 2 0		Rain.	W by S	Cloudy, with rain.
3	37 2 0	32 2 0			W by S	Clear.
4	17 2 0	24 2 0			N	Clear.
5	18 2 0	28 2 0	4		N by E	Cloudy, with snow all day.
6	19 2 0	23 2 0			N by E	Clear.
7	18 2 0	29 2 0			NE	Clear.
8	30 2 0	20 2 0	2		W	Cloudy, with some snow.
9	24 2 0	28 2 0			NW	Clear.
10	10 2 0	19 2 0			N	Clear.
11	10 2 0	20 2 0			N	Clear.
12	16 2 0	25 2 0	6		NE	Cloudy, with a great fall of snow.
13	21 2 0	22 2 0			W by N	Cloudy.
14	1 2 0	19 2 0			E	Clear and almost calm.
15	19 2 0	21 2 0			E	Clear.
16	11 2 0	23 2 0			NW	Clear.
17	11 2 0	14 2 0			NW	Clear.
18	10 2 0	21 2 0			NW	Clear.
19	15 2 0	14 2 0			N by E	Cloudy.
20	6 2 0	16 2 0			N by E	Clear.
21	6 2 0	29 2 0			N by E	Clear.
22	27 2 0	26 2 0	8		NE	Cloudy, with a great quantity of snow.
23	25 2 0	29 2 0			NE	Cloudy.
24	12 2 0	29 2 0			N	Cloudy, with a thick fog.
25	26 2 0	27 2 0	4		NE	Cloudy, with snow.
26	26 2 0	31 2 0			W	Clear.
27	25 2 0	28 2 0			W	Clear.
*28	24 2 0	40 2 0			SW	Clear.
29	32 2 0	41 2 0			NW	Clear.
30	31 2 0	40 2 0		Rain.	N by E	Cloudy, with rain.
31	40 2 0	42 2 0		Rain.	N by E	Cloudy, with rain.

* This day and yesterday the ice on the river began to be rotten, and crossing to be hazardous.

FOR

FOR APRIL, 1779.

Days.	Thermometer. Morning	Evening.	Snow.	Rain.	Winds.	Remarks.
	°	°	Inch.			
1	40 a 0	46 a 0		Rain.	SW	Cloudy, with a thick fog and rain.
2	41 a 0	45 a 0			SW	Cloudy, with a thick fog and rain.
3	30 a 0	51 a 0		Rain.	NE	Cloudy, wind SW in the evening.
4	35 a 0	41 a 0			W	Clear.
5	36 a 0	42 a 0			W	Clear.
6	37 a 0	38 a 0		Rain.	SW	Cloudy, with a little rain.
7	32 a 0	36 a 0			W	Cloudy.
8	32 a 0	49 a 0			SW	Cloudy.
9	42 a 0	44 a 0			S	Cloudy.
10	40 a 0	42 a 0			E	Cloudy.
11	35 a 0	44 a 0		Rain.	E	Cloudy.
12	42 a 0	45 a 0		Rain.	E	Cloudy, a very heavy rain.
13	39 a 0	40 a 0			W	Clear.
14	31 a 0	45 a 0			NE	Clear.
15	46 a 0	50 a 0			NW	Clear.

It is worth obſerving, that the great quantity of ſnow on the ground has, from the 29th of March to the 4th of April, been chiefly melted away by the heat of the ſun, for the rain during that period has been very inconſiderable.

No *refoulement* of the river this ſpring; the ice gave way in the middle of the river firſt, and the opening has been growing larger and larger every day ſince the 28th of March, and is this day, the 4th of April, very large, although the ice remains faſt on the border of the river.

FOR APRIL, 1790.

Day of the Month.	Morning.	Noon.	Evening.	Snow fallen.	Wind.	Remarks.
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
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METEOROLOGICAL JOURNAL

KEPT AT THE HOUSE OF

THE ROYAL SOCIETY,

BY ORDER OF THE

PRESIDENT AND COUNCIL.

METEOROLOGICAL JOURNAL
for January 1778.

	Time. H.	M.	Therm. without	Therm. within.	Barom.	Rain.	Winds. Points.	Str.	Weather.
					Inches.	Inch.			
Jan. 1	8	0	33,5	48,5	29,66	0,116	NNW	3	Rain, violent wind laſt n.
	2	0	32,5	37,0	29,85		N by W	3	Fair.
2	8	0	33,5	35,5	30,26		NNE	1	Cloudy.
	2	0	36,0	37,0	30,38		NW	1	Fine.
3	8	0	26,5	33,5	30,55		NNE	1	Fair and frosty.
	2	0	32,0	34 0	30,51		N by W	1	Fine.
4	8	0	25.0	31,5	30,49		WNW	1	Foggy and frosty.
	2	0	28,0	33,0	30,45		NW	1	Fine.
5	8	0	32,0	34,5	30,28		SSW	1	Foggy.
	2	0	37,0	32,0	30,26		SW	1	Fine.
6	8	0	37,0	36,0	30,23		NE	1	Fair.
	2	0	42,0	38,0	30,27		NE	1	Cloudy and rainy.
7	8	0	31,0	35,5	30,45		NE	1	Foggy.
	2	0	37,5	36,5	30,54		NE	1	Fine.
8	8	0	29,0	34,0	30,55		ENE	1	Foggy and frosty.
	2	0	34,0	34,5	30,61		NE	1	Fine.
9	8	0	28,0	32,0	30,50		N by E	1	Frosty.
	2	0	37,0	34,5	30,47		NE	1	Fine.
10	8	0	36,5	36,0	30,40		NE	1	Cloudy.
	2	0	38,0	37,0	30,42		NE	1	Cloudy.
11	8	0	29,0	34,0	30,41		NE	1	Foggy.
	2	0	35,0	35,5	30,39		ENE	1	Fair.
12	8	0	26,0	32,0	30,44		NE	1	Fair and frosty.
	2	0	36,0	35,0	30,42		N by E	1	Fine.
13	8	0	36,0	35,0	30,41		N by E	1	Foggy.
	2	0	40,0	37,0	30,42		NE	1	Cloudy and rainy.
14	8	0	33,0	36,0	30,33		N by W	1	Foggy.
	2	0	37,0	37,5	30,35		NW	1	Fair.
15	8	0	32,5	36,0	30,28		NE	1	Fine.
	2	0	34,5	37,5	30,29		NE	1	Fine.
16	8	0	32,5	35,0	30,19		NNE	1	Foggy.
	2	0	35,0	36,0	30,21		NE	1	Foggy and ſnow.

METEOROLOGICAL JOURNAL
for January 1779.

	Time.	Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
				Inches.	Inch.	Points.	Str.	
Jan. 17	8 o	34,0	36,0	30,30		NE	1	Foggy.
	2 o	36,0	36,5	30,27		NNE	1	Cloudy.
18	8 o	32,0	35,0	30,22		S by W	1	Cloudy.
	2 o	34,0	36,0	30,28		SW	1	Rain.
19	8 o	35,0	35,0	30,27		SSW	1	Foggy.
	2 o	45,0	37,0	30,37		SW	1	Foggy.
20	8 o	38,0	39,0	30,49	0,027	S	1	Foggy.
	2 o	45,0	48,5	30,52		SW	1	Foggy.
21	8 o	38,0	40,0	30,35		S by E	1	Cloudy.
	2 o	44,5	42,5	30,29		SE	1	Fine.
22	8 o	41,0	42,5	30,20		S by W	1	Fair.
	2 o	49,0	44,5	30,24		SW	1	Fine.
23	8 o	40,0	42,0	30,37		W	1	Fair.
	2 o	48,0	44,5	30,34		SW	1	Fine.
24	8 o	37,0	44,0	30,33		S by E	1	Cloudy.
	2 o	49,0	43,5	30,24		S by W	1	Fine.
25	8 o	39,0	42,0	29,95		S by E	1	Fair.
	2 o	45,0	43,0	29,93		SE	1	Rainy and cloudy.
26	8 o	39,0	41,0	29,87	0,020	ESE	1	Fair.
	2 o	45,5	42,5	29,81		ESE	1	Fine.
27	8 o	41,0	42,5	29,66		S by E	1	Cloudy.
	2 o	44,5	43,5	29,63		S by E	1	Rainy.
28	8 o	39,0	41,5	29,86	0,033	WNW	1	Cloudy.
	2 o	41,0	42,5	29,99		NW	1	Cloudy.
29	8 o	31,5	39,0	30,15		SSW	1	Fair.
	2 o	43,0	41,5	30,25		SW	1	Fine.
30	8 o	43,0	40,0	30,24		SW	1	Cloudy.
	2 o	50,0	43,0	30,31		SW	1	Fine.
31	8 o	45,0	45,0	30,39		WSW	1	Cloudy.
	2 o	48,5	45,5	30,44		SW	1	Fine.

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	Time.	Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
				Inches.	Inch.	Points.	Str.	
Feb. 1	8 0	43,0	46,0	30,41		W	1	Fair.
	2 0	48,0	47,0	30,45		NW	1	Cloudy.
2	8 0	41,0	46,0	30,42		SSW	1	Fair.
	2 0	50,0	47,0	30,41		SW	1	Fine.
3	8 0	37,0	44,0	30,31		ENE	1	Foggy.
	2 0	45,0	45,0	30,26		NW	1	Fine.
4	8 0	46,0	47,0	30,14		W by N	1	Fair.
	2 0	50,0	48,0	30,14		NW	1	Fine.
5	8 0	48,0	49,5	30,07		WSW	2	Cloudy.
	2 0	51,0	49,5	30,10		WSW	2	Fine.
6	8 0	47,0	49,0	30,12		SW	2	Fine.
	2 0	55,0	52,5	30,14		SW	2	Fine.
7	8 0	50,0	51,0	30,32		WSW	1	Cloudy.
	2 0	55,5	53,5	30,32		WSW	1	Cloudy.
8	8 0	47,0	52,0	30,39		W by S	1	Cloudy.
	2 0	52,5	53,0	30,44		SW	1	Fine.
9	8 0	48,0	51,5	30,36		ENE	1	Cloudy.
	2 0	52,5	53,5	30,34		ENE	1	Cloudy.
10	8 0	45,0	49,5	30,11		SW	1	Cloudy.
	2 0	47,5	50,5	30,11		S by W	1	Cloudy.
11	8 0	42,0	48,5	30,14		SE	1	Fine.
	2 0	52,0	50,0	30,12		SE	1	Fine.
12	8 0	45,0	47,0	29,85		SSE	1	Fair.
	2 0	51,0	48,0	29,84		SW	1	Fine.
13	8 0	49,0	48,0	29,85		SW	2	Cloudy.
	2 0	53,0	51,0	29,96		SW	2	Fine, much wind.
14	8 0	48,0	50,0	29,98	0,164	SW	1	Fair.
	2 0	53,0	51,5	30,10		SW	1	Fine.
15	8 0	40,0	47,0	30,44	0,025	SSW	1	Cloudy.
	2 0	52,0	49,0	30,44		SW	1	Fine.
16	8 0	47,0	48,0	30,27		SSW	1	Cloudy.
	2 0	53,0	50,0	30,39		SW	1	Fine.

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	Time.	Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
				Inches.	Inch.	Points.	Str.	
Feb. 17	8 o	43,0	47,5	30,46		SW	1	Cloudy.
	2 o	57,0	50,0	30,51		SW	1	Fine.
18	8 o	44,5	49,0	30,46		SSW	1	Fine.
	2 o	55,5	51,0	30,44		S by W	1	Fine.
19	8 o	41,0	48,0	30,44		SW	1	Fine.
	2 o	54,5	50,5	30,53		SW	1	Fine.
20	8 o	38,0	47,0	30,52		SSW	1	Foggy.
	2 o	47,5	49,0	30,50		S by W	1	Fine.
21	8 o	40,0	45,0	30,34		SSW	1	Cloudy.
	2 o	46,0	47,0	30,29		WSW	1	Cloudy.
22	8 o	40,5	45,0	30,22		SW	1	Cloudy.
	2 o	40,0	46,5	30,21		SW	1	Fine.
23	8 o	40,0	44,5	30,17		S by W	1	Fair.
	2 o	50,0	45,0	30,14		SW	1	Fine.
24	8 o	43,0	46,0	30,10		E by N	1	Fine.
	2 o	51,0	47,0	30,16		NE	1	Cloudy.
25	8 o	43,0	47,0	30,21	0,050	SSE	1	Cloudy.
	2 o	52,5	49,5	30,22		S by E	1	Fine.
26	8 o	47,0	49,0	30,23		S by E	1	Fair.
	2 o	59,0	52,0	30,26		SW	1	Cloudy.
27	8 o	48,0	50,0	30,17		SW	1	Foggy.
	2 o	60,5	53,0	30,53		SW	1	Fine.
28	8 o	43,0	50,0	30,19		SSE	1	Fair.
	2 o	58,0	52,0	30,38		NE	1	Foggy.

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for March 1779.

	Time.	Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
				Inches.	Inch.	Points.	Str.	
Mar. 1	7 o	39,5	49,0	30,16		SSW	1	Fair.
	2 o	59,0	51,0	30,17		SSW	1	Fine.
2	7 o	44,0	49,0	30,27		NNW	1	Fair.
	2 o	50,5	50,0	30,29		W by N	1	Fine.
3	7 o	34,5	45,0	30,34		SSW	1	Fine.
	2 o	50,0	47,5	30,37		SW	1	Fair.
4	7 o	45,0	47,0	30,49	0,051	S by E	1	Rainy.
	2 o	50,5	49,0	30,56		S by W	1	Cloudy.
5	7 o	37,0	47,0	30,60		ENE	1	Foggy.
	2 o	50,0	50,0	30,63		NE	1	Fine.
6	7 o	36,0	43,5	30,57		NNE	1	Foggy.
	2 o	51,0	46,5	30,61		NW	1	Fine.
7	7 o	40,0	44,0	30,48		NE	1	Fair.
	2 o	47,5	46,5	30,45		ENE	1	Cloudy.
8	7 o	39,0	44,0	30,41		ENE	1	Fine.
	2 o	52,0	48,0	30,40		NE	1	Fine.
9	7 o	37,0	43,5	30,32		NE	1	Fine.
	2 o	52,0	48,0	30,32		NE	1	Fine.
10	7 o	41,0	44,5	30,24		ENE	1	Cloudy.
	2 o	50,0	46,5	30,17		NE	1	Fine.
11	7 o	38,5	44,5	30,06		E	1	Fair.
	2 o	50,0	46,0	30,00		ENE	1	Fine.
12	7 o	33,0	42,0	29,93		ENE	1	Fine.
	2 o	54,5	45,5	29,95		NE	1	Fine.
13	7 o	37,0	44,0	30,14		SSW	1	Fine.
	2 o	50,0	48,0	30,14		SW	1	Fine.
14	7 o	41,0	45,0	30,15		SW	1	Fair.
	2 o	50,0	48,0	30,09		SW	1	Rainy.
15	7 o	44,0	48,0	29,84	0,052	WNW	1	Fine.
	2 o	52,0	50,0	29,96		NW	1	Cloudy.
16	7 o	38,5	45,0	30,06		NNE	1	Cloudy.
	2 o	47,0	47,0	30,05		NE	1	Fine.

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	Time.	Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
	H. M.			Inches.	Inch.	Points.	Str.	
Mar. 17	7 0	40,0	44,5	29,95		S by W	1	Cloudy.
	2 0	50,0	47,0	29,89		SW	1	Fine.
18	7 0	44,0	45,5	29,64	0,381	SSE	1	Rainy.
	2 0	52,0	49,0	29,63		SE	1	Fair.
19	7 0	43,0	48,5	29,64		W by S	1	Fine.
	2 0	54,5	51,0	29,72		W by S	1	Fine.
20	7 0	50,0	51,0	29,80	0,029	S by W	1	Cloudy.
	2 0	56,0	54,0	29,79		SSW	1	Fine.
21	7 0	46,0	52,0	29,72		WSW	2	Cloudy.
	2 0	49,5	53,0	29,79		W by S	2	Showery with ſun-ſhine.
22	7 0	45,0	49,0	30,27	0,010	W by S	1	Fine.
	2 0	55,0	52,0	30,34		SW	1	Fair.
23	7 0	49,0	51,0	30,33		SW	1	Fair.
	2 0	57,0	52,0	30,36		SW	1	Fine.
24	7 0	47,0	49,0	30,32		SSW	1	Fine.
	2 0	62,0	53,0	30,35		SW	1	Fine.
25	7 0	39,5	49,5	30,31		NNE	1	Fine.
	2 0	60,0	54,0	30,29		NW	1	Fine.
26	7 0	42,0	50,0	30,15		NW	1	Fine.
	2 0	61,0	53,0	30,07		NW	1	Fine.
27	7 0	42,0	53,0	30,08		NW	1	Fine.
	2 0	60 0	56,0	30,17		NW	1	Fine.
28	7 0	42,0	50,0	30,11		NW	1	Fine.
	2 0	73,0	52,0	30,48		NE	1	Fine.
29	7 0	42,0	47,0	30,40		NE	1	Fine.
	2 0	73,0	49,0	30,43		N by E	1	Fine.
30	7 0	38,0	35,0	30,35		NE	1	Fine.
	2 0	51,0	48,0	30,29		SE	1	Fine.
31	7 0	36,0	44,0	30,30		NE	1	Fine
	2 0	57,0	48,5	30,29		NE	1	Fine.

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	Time. H.	M.	Therm. without	Therm. within.	Barom. Inches.	Rain. Inch.	Winds. Points.	Str.	Weather.
Apr. 1	7	0	43,0	47,0	30,44		NE	1	Cloudy.
	2	0	50,0	49,0	30,48		NE	1	Cloudy.
2	7	0	38,0	44,0	30,54		NE	1	Fine.
	2	0	56,0	51,0	30,59		NE	1	Fine.
3	7	0	38,0	44,5	30,49		NE	1	Fine.
	2	0	62,0	58,0	30,43		NE	1	Fine.
4	7	0	40,0	46,5	30,25		NE	1	Fine.
	2	0	65,0	51,0	30,18		WSW	1	Fine.
5	7	0	47,0	50,0	30,09		NE	1	Fair.
	2	0	67,5	55,0	30,05		SSE	1	Fine.
6	7	0	47,0	51,0	30,03		SE	1	Fine.
	2	0	67,0	57,0	30,25		SE	1	Fine.
7	7	0	51,0	52,0	30,19	0,051	SSW	1	Cloudy.
	2	0	60,5	57,0	30,14		S by W	2	Cloudy.
8	7	0	53,0	54,0	29,84		S by W	2	Fine.
	2	0	63,0	59,0	29,73		SW	2	Cloudy and rain.
9	7	0	43,5	53,5	29,77	0,175	WSW	2	Fine.
	2	0	54,0	55,0	29,81		SW	2	Rainy.
10	7	0	44,5	49,5	29,97	0,027	W by S	1	Fair.
	2	0	52,0	54,0	29,99		SW	1	Cloudy with little rain.
11	7	0	53,0	51,0	30,00		SW	2	Fair.
	2	0	64,0	56,5	30,03		SW	2	Fine.
12	7	0	51,0	52,0	30,10		S by W	1	Cloudy.
	2	0	62,0	58,0	30,14		SW	1	Cloudy.
13	7	0	52,0	54,0	30,12	0,010	SW	1	Fair.
	2	0	66,0	60,0	30,12		SW	1	Fine.
14	7	0	48,0	56,5	30,05		SW	1	Fair.
	2	0	71,0	61,0	29,99		SW	1	Fine.
15	7	0	52,0	58,0	29,85		ENE	1	Fine.
	2	0	78,0	64,0	29,86		SW	1	Fine.
16	7	0	51,5	60,0	29,90		ENE	1	Cloudy.
	2	0	55,0	60,0	29,96		NE	1	Cloudy.

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	Time. H.	M.	Therm. without	Therm within.	Barom. Inches.	Rain. Inch.	Winds. Points.	Str.	Weather.
Apr. 17	7	0	48,0	53,0	30,19		E by S	1	Cloudy.
	2	0	55,0	55,5	30,20		E by S	2	Cloudy.
18	7	0	51,5	52,5	30,06		ESE	1	Fine.
	2	0	69,0	60,5	29,99		E	1	Fine.
19	7	0	57,5	59,0	29,96	0,016	SSW	1	Cloudy.
	2	0	68,5	62,5	30,03		SW	1	Fine.
20	7	0	54,0	58,0	30,09		SSW	1	Fine.
	2	0	66,0	62,0	30,07		SW	2	Fine.
21	7	0	53,0	59,0	29,82	0,100	W by S	2	Fine.
	2	0	61,0	60,0	29,78		S by W	2	Fine.
22	7	0	55,0	57,0	29,81	0,033	SSW	3	Cloudy.
	2	0	60,0	57,5	29,77		SW	2	Cloudy.
23	7	0	47,0	54,0	29,66	0,210	W by S	2	Cloudy and rain.
	2	0	56,0	56,5	29,74		SSW	3	Cloudy.
24	7	0	49,0	53,0	29,60	0,245	SW	2	Fair.
	2	0	45,0	54,0	29,58		SW	2	Showery.
25	7	0	45,0	50,0	29,78	0,218	W by N	2	Fine.
	2	0	57,0	52,5	29,88		SW	2	Fine.
26	7	0	49,0	52,0	29,43	0,094	W by S	2	Fine.
	2	0	58,0	54,5	29,55		NW	2	Fine.
27	7	0	46,0	51,0	29,60		SW	2	Fine.
	2	0	47,0	52,5	29,65		NW	2	Showery.
28	7	0	45,0	50,0	29,57	0,045	WSW	2	Fine.
	2	0	55,0	52,0	29,59		SW	2	Fine.
29	7	0	50,0	50,5	29,65		WSW	2	Cloudy.
	2	0	56,5	54,0	29,69		W by S	2	Fine.
30	7	0	45,0	50,0	29,74		NE	1	Fine.
	2	0	59,0	53,5	29,79		E by N	1	Fine.

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	Time. H.	Time. M.	Therm. without	Therm. within	Barom. Inches.	Rain. Inch.	Winds. Points.	Winds. Str.	Weather.
May 1	7	0	47,0	52,0	29,52	0,342	NNE	1	Rainy.
	2	0	48,0	52,0	29,51		NNW	1	Rainy.
2	7	0	41,5	48,0	29,80	0,021	NNE	1	Fine.
	2	0	55,5	51,3	29,81		SSW	1	Fine.
3	7	0	43,0	48,5	29,68		N by E	1	Rainy.
	2	0	45,0	50,0	29,65		N by E	1	Rainy.
4	7	0	42,0	45,0	29,64	0,240	N by W	1	Rainy.
	2	0	50,0	48,0	29,69		NW	1	Cloudy.
5	7	0	42,0	45,0	29,65		NNW	1	Cloudy.
	2	0	45,0	48,0	29,62		NW	1	Rainy.
6	7	0	47,0	48,0	29,82	0,202	SSW	1	Fair.
	2	0	61,0	52,0	29,80		SW	1	Cloudy.
7	7	0	53,0	53,5	29,71	0,015	SSW	1	Fair.
	2	0	60,0	55,0	29,74		SW	1	Showery, but fun-ſhine.
8	7	0	51,0	53,0	29,67	0,094	ESE	1	Fine.
	2	0	56,0	55,0	29,61		ENE	1	Showery.
9	7	0	53,0	55,0	29,63	0,083	SSW	1	Cloudy.
	2	0	65,0	58,5	29,77		SSW	1	Fine.
10	7	0	51,0	51,5	29,69		ENE	1	Fine.
	2	0	70,0	68,5	29,64		SW	1	Fine.
11	7	0	52,0	57,0	29,67	0,085	WSW	1	Fine.
	2	0	65,0	61,0	29,78		SSW	1	Fine.
12	7	0	49,0	57,5	29,87		SW	1	Fine.
	2	0	64,0	60,0	29,93		SSW	1	Fine.
13	7	0	55,5	58,0	29,91		W	1	Fine.
	2	0	68,0	61,5	29,96		WNW	1	Fine.
14	7	0	53,0	59,0	29,93		SSW	1	Fine.
	2	0	67,5	62,0	29,97		SSW	1	Fine.
15	7	0	58,0	60,0	29,92		SSW	1	Fair.
	2	0	67,0	63,0	29,93		W by S	1	Fair.
16	7	0	57,0	60,5	29,86	0,039	SSW	1	Rainy.
	2	0	60,0	62,5	29,86		SW	2	Cloudy and ſhowery.

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	Time.		Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
	H.	M.			Inches.	Inch.	Points.	Str.	
May 17	7	0	58,0	61,0	29,78	0,087	SSW	2	Cloudy.
	2	0	66,0	64,0	29,80		SSW	2	Fine.
18	7	0	59,0	62,0	29,83		SSW	2	Cloudy, with little sun-sh.
	2	0	58,5	62,0	29,78		SW	2	Rain.
19	7	0	53,5	60,0	29,78	0,315	WSW	2	Cloudy.
	2	0	63,5	61,5	29,81		WSW	2	Showery.
20	7	0	52,0	58,0	29,83	0,146	WSW	2	Cloudy.
	2	0	58,0	59,0	29,88		SW	2	Cloudy.
21	7	0	55,5	57,0	30,02	0,039	SW	1	Cloudy.
	2	0	60,0	59,5	30,06		SW	2	Cloudy.
22	7	0	55,0	58,0	30,16		NW	1	Fine.
	2	0	66,0	61,5	30,16		NW	1	Fine.
23	7	0	58,0	59,5	30,19		ENE	1	Fine.
	2	0	78,0	66,0	30,12		SE	1	Fine.
24	7	0	65,5	66,0	30,03		S by W	1	Fine.
	2	0	82,5	71,5	30,07		S by W	1	Fine.
25	7	0	63,0	60,0	30,20		ENE	1	Fine.
	2	0	80,0	73,5	30,20		NE	1	Fine.
26	7	0	54,5	61,0	30,12		NE	1	Cloudy.
	2	0	75,0	70,0	30,12		E	1	Fine.
27	7	0	57,5	64,0	30,09		NE	1	Fair.
	2	0	70,0	67,5	30,12		NE	1	Fine.
28	7	0	54,5	63,0	30,03		NE	1	Fair.
	2	0	74,5	68,0	30,02		NE	1	Fine.
29	7	0	64,5	65,5	29,96		ENE	1	Fine.
	2	0	77,5	79,0	30,04		E by N	1	Fine.
30	7	0	56,0	64,0	30,22		ENE	1	Fair.
	2	0	62,0	65,0	30,27		NE	1	Cloudy.
31	7	0	56,5	57,5	30,19		NE	1	Fine.
	2	0	66,5	62,0	30,20		NE	1	Fine.

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	Time. H.	Time. M.	Therm. without	Therm. within.	Barom. Inches.	Rain. Inch.	Winds. Points.	Winds. Str.	Weather.
June 1	7	0	56,0	61,0	30,08		NE	1	Fine.
	2	0	67,5	63,0	30,02		E by N	1	Fine.
2	7	0	53,5	57,5	30,02		N by E	1	Fine.
	2	0	70,0	62,0	30,14		NE	1	Fine.
3	7	0	56,0	58,0	29,98		NE	1	Fine.
	2	0	67,0	63,5	30,04		NE	1	Fine.
4	7	0	54,0	56,5	29,97		S by E	1	Fine.
	2	0	70,0	63,5	29,95		NW	1	Fine.
5	7	0	54,0	61,0	29,90		NW	1	Fine.
	2	0	67,0	63,5	29,87		N by E	1	Fine.
6	7	0	56,0	51,5	29,90		ENE	1	Fine.
	2	0	71,0	65,0	29,89		SE	1	Fine.
7	7	0	62,0	63,0	29,78		ESE	1	Fine.
	2	0	73,5	68,0	29,73		SSE	1	Fine.
8	7	0	61,0	65,0	29,54	0,086	SSW	1	Fine.
	2	0	70,0	68,0	29,48		SW	1	Fine.
9	7	0	57,0	65,0	29,48	0,028	SW	2	Cloudy.
	2	0	68,0	66,0	29,51		SW	2	Cloudy.
10	7	0	59,5	64,5	29,66	0,040	SSW	1	Cloudy.
	2	0	62,0	65,0	29,72		SW	1	Cloudy.
11	7	0	53,0	61,5	29,65	0,303	N by W	1	Rainy.
	2	0	53.0	62,0	29,64		NE	2	Rainy.
12	7	0	55.5	61,0	29,50	1,198	ENE	1	Cloudy.
	2	0	70,0	65,0	29,55		S by E	1	Fine.
13	7	0	58,0	61,0	29,53		W by S	1	Fair.
	2	0	72,0	65,5	29,51		S by E	1	Fine.
14	7	0	58,0	63,5	29,57		NE	1	Fair.
	2	0	71,0	66,5	29,64		NW	1	Fair.
15	7	0	59,5	64,0	29,90		NNE	1	Fine.
	2	0	71,5	69,0	30,00		NNE	1	Fine.
16	7	0	53,5	61,0	30,11		N by W	2	Cloudy.
	2	0	62,0	65,0	30,15		N	2	Fair.

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	Time.		Therm. without	Therm within.	Barom.	Rain.	Winds.		Weather.
	H.	M.			Inches.	Inch.	Points.	Str.	
June 17	7	0	54,5	60,0	30,15		N by W	1	Cloudy.
	2	0	72,0	63,0	30,17		NW	1	Fine.
18	7	0	56,0	59,0	30,05		SW	1	Fair.
	2	0	75,0	65,0	29,97		NW	1	Fine.
19	7	0	55,0	61,0	29,97		NW	1	Fine.
	2	0	61,5	62,0	29,97		WSW	1	Fine.
20	7	0	52,5	59,5	30,10	0,058	NW	1	Fine.
	2	0	62,5	61,0	30,12		NW	1	Fine.
21	7	0	58,0	60,0	30,16		W by N	1	Fine.
	2	0	71,0	64,0	30,16		WSW	1	Fine.
22	7	0	56,5	61,5	30,15	0,120	NNW	1	Rainy.
	2	0	61,0	63,0	30,22		NW	1	Cloudy.
23	7	0	57,0	60,5	30,21		N by E	1	Fine.
	2	0	62,5	64,0	30,22		NE	1	Cloudy.
24	7	0	56,5	60,0	30,13		NNE	1	Fine.
	2	0	63,0	63,0	30,13		NW	1	Cloudy.
25	7	0	55,0	60,0	29,92	0,385	N by E	1	Rainy.
	2	0	60,0	62,0	29,89		NNE	1	Showery.
26	7	0	58,0	61,0	29,92	0,258	NE	2	Fine.
	2	0	69,0	65,0	29,99		NE	2	Fine.
27	7	0	55,0	58,5	30,02		N by E	2	Fair.
	2	0	65,5	63,5	30,01		ENE	2	Fine.
28	7	0	57,0	60,0	30,02		ENE	1	Cloudy.
	2	0	68,0	64,0	30,01		NNE	1	Fine.
29	7	0	54,5	60,0	30,06		N by E	1	Fair.
	2	0	69,0	66,0	30,12		N by E	1	Fine.
30	7	0	57,5	61,0	30,22		SSW	1	Fine.
	2	0	72,0	65,5	30,21		S by W	1	Fine.

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	Time.	Therm. without	Therm. within	Barom.	Rain.	Winds.		Weather.
	H. M.			Inches.	Inch.	Points.	Str.	
July 1	7 0	62,5	64,0	30,08		SSW	1	Fine.
	2 0	73,0	68,0	30,00		SW	1	Fine.
2	7 0	59,0	64,5	29,85		N by W	1	Fine.
	2 0	76,0	69,0	29,81		NW	1	Fine.
3	7 0	61,0	65,0	29,60	0,160	NW	1	Rainy.
	2 0	63,0	67,0	29,50		NW	1	Rainy.
4	7 0	61,0	64,0	29,47	0,500	SSE	1	Fine.
	2 0	68,0	65,0	29,35		SE	1	Rainy.
5	7 0	59,0	64,5	29,52	1,000	S by W	2	Fine.
	2 0	65,0	66,0	29,35		SW	2	Showery.
6	7 0	57,0	63,0	29,30	0,228	SW	1	Rainy.
	2 0	63,0	65,0	29,48		SW	1	Cloudy.
7	7 0	60,0	64,0	29,76	0,160	N by E	1	Fair.
	2 0	66,5	66,0	29,89		NNW	1	Showery.
8	7 0	60,0	64,5	30,14	0,020	NNW	1	Fine.
	2 0	73,5	67,5	30,17		N	1	Fine.
9	7 0	60,0	66,5	30,30		NNE	1	Fine.
	2 0	78,0	70,0	30,28		NE	1	Fine.
10	7 0	64,0	67,0	30,28		SSW	1	Fine.
	2 0	80,0	73,5	30,29		NW	1	Fine.
11	7 0	69,0	65,0	30,34		NW	1	Fine.
	2 0	82,0	76,5	30,38		NNW	1	Fine.
12	7 0	65,0	73,5	30,41		N by W	1	Fair.
	2 0	81,0	76,5	30,42		NW	1	Fine.
13	7 0	65,5	73,5	30,33		NW	1	Fine.
	2 0	84,0	80,5	30,29		NW	1	Fine.
14	7 0	66,0	69,0	30,27		ENE	1	Fine.
	2 0	77,0	77,0	30,31		NE	1	Fine.
15	7 0	66,0	69,0	30,34		ESE	1	Fine.
	2 0	74,0	76,5	30,38		SE	1	Fine.
16	7 0	69,0	74,0	30,29		SSW	1	Fine.
	2 0	82,0	81,0	30,34		NE	1	Fine.

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	Time. H.	M.	Therm. without	Therm. within.	Barom. Inches.	Rain. Inch.	Winds. Points.	Str.	Weather.
July 17	7	0	64,5	67,0	30,25		ESE	1	Fine.
	2	0	74,0	72,0	30,21		SE	1	Fine.
18	7	0	67,5	68,0	30,11		E by S	1	Fine.
	2	0	85,0	75,0	30,09		SSE	1	Fine.
19	7	0	63,0	72,0	30,00		SW	1	Fair.
	2	0	77,5	76,0	29,95		SW	1	Cloudy.
20	7	0	64,0	70,0	29,88		SSW	1	Fine.
	2	0	76,0	74,5	29,84		SW	1	Fine.
21	7	0	63,5	70,5	29,72		NNW	1	Fair.
	2	0	62,0	70,0	29,54		NW	1	Rainy.
22	7	0	62,0	68,5	29,58	2,867	SSW	1	Fine.
	2	0	64,0	68,5	29,52		SE	1	Showery.
23	7	0	61,0	66,0	29,33	0,853	SE	1	Rainy.
	2	0	60,5	68,0	29,32		NE	1	Rainy.
24	7	0	61,0	66,0	29,63	0,140	NW	1	Fair.
	2	0	70,0	68,5	29,66		N by W	1	Fine.
25	7	0	64,5	68,0	29,74		SSW	1	Fair.
	2	0	74,0	70,5	29,71		NW	1	Fine.
26	7	0	60,0	67,5	29,76	0,269	NNE	1	Fair.
	2	0	71,5	70,0	29,84		NE	1	Fine.
27	7	0	59,0	67,0	29,92		S	1	Fine.
	2	0	73,0	70,0	29,97		SW	1	Cloudy.
28	7	0	64,0	66,0	29,85		WSW	1	Cloudy.
	2	0	78,0	74,0	29,88		SW	1	Fine.
29	7	0	67,0	71,0	29,81	0,029	SW	1	Cloudy.
	2	0	76,5	74,0	29,78		SW	1	Fair.
30	7	0	64,0	69,0	29,67		SSW	1	Cloudy.
	2	0	73,0	72,0	29,69		WSW	1	Showery.
31	7	0	62,0	69,0	29,79	0,175	NW	2	Cloudy.
	2	0	66,0	69,0	29,89		WSW	2	Cloudy.

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	Time.	Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
	H. M.			Inches.	Inch.	Points.	Str.	
Aug. 1	7 0	59,5	67,0	30,09		S by W	1	Fine.
	2 0	75,0	70,0	30,08		SW	1	Fine.
2	7 0	62,0	68,0	30,03		SSW	1	Fine.
	2 0	79,0	72,0	29,96		SSW	1	Fine.
3	7 0	60,0	69,0	30,01	0,044	SW	1	Fine.
	2 0	73,5	72,5	30,08		NW	1	Fine.
4	7 0	63,5	69,5	29,97		SSW	1	Cloudy.
	2 0	67,0	70,0	29,90		SSW	1	Rain.
5	7 0	61,0	67,0	29,82	0,110	S by E	1	Rainy.
	2 0	69,0	69,5	29,78		SSW	1	Showery.
6	7 0	58,0	66,0	29,70	0,054	NNW	1	Rainy.
	2 0	57,0	65,5	29,67		NNW	1	Rainy.
7	7 0	55,0	62,0	29,64	0,712	NW	1	Rainy.
	2 0	64,0	66,0	29,68		NW	1	Rainy.
8	7 0	63,0	66,0	29,85	0,094	N by W	1	Fine.
	2 0	72,5	69,0	29,88		N by W	1	Fine.
9	7 0	60,5	66,0	29,86		NW	1	Cloudy.
	2 0	68,0	68,5	29,91		NW	1	Cloudy.
10	7 0	63,5	67,0	30,05		NNW	1	Cloudy.
	2 0	72,0	70,5	30,08		N by W	1	Cloudy.
11	7 0	62,0	68,0	30,08		ENE	1	Cloudy.
	2 0	76,0	72,5	30,11		NNE	1	Fine.
12	7 0	63,0	69,5	30,08		SSE	1	Cloudy.
	2 0	74,5	72,0	30,08		N	1	Fine.
13	7 0	63,0	69,5	30,12		S by W	1	Fair.
	2 0	75,0	72,0	30,09		S by W	1	Fine.
14	7 0	64,0	70,5	30,12		E by N	1	Fair.
	2 0	77,5	73,5	30,11		E by S	1	Fine.
15	7 0	65,0	67,0	30,11		SE	1	Cloudy.
	2 0	81,0	77,0	30,01		SSE	1	Fine.
16	7 0	62,0	71,0	30,05		S by E	1	Fair.
	2 0	77,0	73,0	30,07		SE	1	Fine.

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	Time.		Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
	H.	M.			Inches.	Inch.	Points.	Str.	
Aug. 17	7	0	62,0	69,0	30,09		NNE	1	Fine.
	2	0	74,0	73,5	30,13		NE	1	Fine.
18	7	0	60,0	67,5	30,17		NE	1	Fine.
	2	0	74,0	73,5	30,22		NE	1	Fine.
19	7	0	61,5	67,0	30,22		NE	1	Fine.
	2	0	74,5	72,5	30,27		SW	1	Fine.
20	7	0	61,5	67,0	30,27		NNE	1	Fair.
	2	0	75,0	70,0	30,29		NNE	1	Fine.
21	7	0	67,0	70,0	30,28		ENE	1	Fine.
	2	0	7 80	72,0	30,29		NE	1	Fine.
22	7	0	65,0	67,0	30,18		NNE	1	Fine.
	2	0	78,0	73,5	30,14		ENE	1	Fine.
23	7	0	63,5	69,5	30,04		N by E	1	Cloudy.
	2	0	65,0	72,0	30,04		NE	1	Rainy.
24	7	0	59,0	67,0	30,07	0,055	N by W	1	Fine.
	2	0	70,0	69,5	30,08		NW	1	Fine.
25	7	0	57,0	65,5	30,13		NE	1	Fair.
	2	0	72,0	68,5	30,10		ENE	1	Fine.
26	7	0	60,5	66,0	30,09		ENE	1	Cloudy.
	2	0	75,0	71,0	30,15		NNE	1	Fine.
27	7	0	62,5	65,5	30,07		E by S	1	Fair.
	2	0	78,0	73,0	30,15		SE	1	Fine.
28	7	0	62,5	67,5	30,18		SE	1	Fine.
	2	0	78,5	72,5	30,20		E	1	Fine.
29	7	0	65,5	71,0	30,23		NE	1	Fine.
	2	0	84,0	75,0	30,22		NE	1	Fine.
30	7	0	64,0	66,5	30,04		ENE	1	Fine.
	2	0	82,0	77,0	30,05		NE	1	Fine.
31	7	0	68,5	71,0	29,92		S	1	Fine.
	2	0	84,5	79,0	29,97		S	1	Fine.

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	Time. H.	Time. M.	Therm. without	Therm. within.	Barom. Inches.	Rain. Inch.	Winds. Points.	Winds. Str.	Weather.
Sept. 1	7	0	61,0	72,0	29,94		NE	1	Fine.
	2	0	79,5	75,5	29,83		ENE	1	Fine.
2	7	0	63,0	73,0	29,80	0,033	WSW	2	Fine.
	2	0	72,0	73,5	29,90		W by S	1	Fine.
3	7	0	59,0	70,0	29,99		NNW	2	Fine.
	2	0	74,5	72,0	29,98		SSW	2	Fine.
4	7	0	63,0	69,0	29,91	0,015	SSW	1	Cloudy.
	2	0	64,0	71,0	29,96		SW	1	Rainy.
5	7	0	57,0	66,0	29,76	0,095	SE	1	Cloudy.
	2	0	67,5	67,0	29,71		S by E	1	Cloudy.
6	7	0	51,5	63,0	29,92		NW	1	Fine.
	2	0	66,0	65,0	30,04		NW	1	Cloudy.
7	7	0	59,0	63,0	30,03	0,017	WSW	2	Cloudy.
	2	0	70,0	68,0	30,04		SW	2	Fine.
8	7	0	63,0	65,5	30,00		W by S	2	Cloudy.
	2	0	72,0	69,0	30,07		NW	2	Fair.
9	7	0	55,0	65,5	30,12		NW	1	Fine.
	2	0	65,0	66,0	30,13		NW	1	Fine.
10	7	0	62,0	64,0	30,07		W by N	1	Fair.
	2	0	72,0	69,0	30,10		N by W	1	Fair.
11	7	0	59,5	64,0	30,17		E by N	1	Fine.
	2	0	73,5	78,0	30,15		S by E	1	Fine.
12	7	0	53,5	60,0	30,03		SE	1	Cloudy.
	2	0	72,0	66,5	29,98		W by N	1	Fine.
13	7	0	61,0	66,0	30,01		W by S	1	Fair.
	2	0	70,0	69,0	30,07		SW	1	Fine.
14	7	0	60,0	65,5	30,01		WNW	1	Cloudy.
	2	0	61,0	66,0	29,99		NW	1	Rainy.
15	7	0	53,0	63,0	29,94	0,316	WSW	1	Fine.
	2	0	68,0	66,0	30,04		NW	1	Fine.
16	7	0	62,0	64,0	30,11		W by S	1	Fair.
	2	0	72,0	69,0	30,20		WSW	1	Fine.

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	Time.		Therm. without	Therm within.	Barom.	Rain.	Winds.		Weather.
	H.	M.			Inches.	Inch.	Points.	Str.	
Sept. 17	7	0	61,0	64,0	30,17		SW	2	Cloudy.
	2	0	69,0	68,0	30,14		SW	2	Fine.
18	7	0	61,5	65,0	29,88		SSW	2	Fine.
	2	0	68,0	64,0	29,73		SW	2	Cloudy.
19	7	0	55,0	62,0	29,79	0,259	WSW	1	Cloudy.
	2	0	58,5	63,0	29,77		WSW	2	Fine.
20	7	0	48,0	58,0	29,91	0,074	W by S	1	Fine.
	2	0	61,5	61,0	29,96		W by S	1	Fine.
21	7	0	52,0	58,0	29,95		SSE	1	Cloudy.
	2	0	65,0	62,0	29,82		SSW	1	Showery.
22	7	0	58,0	60,0	29,75		SW	1	Fair.
	2	0	67,0	65,0	29,78		SW	2	Fine.
23	7	0	56,0	62,0	29,69	0,140	SSW	1	Rainy.
	2	0	62,0	64,0	29,72		SW	1	Rainy.
24	7	0	67,0	63,0	29,56	0,945	SW	1	Rainy.
	2	0	67,0	65,0	29,61		SW	1	Fine.
25	7	0	64,0	65,0	29,54	0,030	SW	2	Cloudy.
	2	0	70,0	68,0	29,55		SW	1	Cloudy.
26	7	0	66,0	68,0	29,78	0,045	SW	1	Cloudy.
	2	0	69,0	68,0	29,78		SW	1	Cloudy.
27	7	0	59,0	66,0	29,72	0,227	SW	1	Cloudy.
	2	0	67,0	67,0	29,88		SW	1	Fine.
28	7	0	57,5	63,5	30,00		S by W	1	Fair.
	2	0	66,0	65,5	30,06		SW	1	Fine.
29	7	0	59,5	63,5	29,96	0,036	SSE	1	Fair.
	2	0	68,0	66,5	29,90		SE	1	Fine.
30	7	0	58,0	64,0	29,68		SE	1	Fine.
	2	0	67,5	66,5	29,69		SE	1	Rainy.

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	Time.	Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
	H. M.			Inches.	Inch.	Points.	Str.	
Oct. 1	7 0	53,5	62,5	29,65	0,079	NNW	1	Cloudy.
	2 0	59,0	62,0	29,74		NW	1	Fine.
2	7 0	45,0	54,0	29,97		N by W	1	Fine.
	2 0	54,5	57,0	30,08		NW	1	Fine.
3	7 0	42,5	50,0	30,11		NNW	1	Fine.
	2 0	52,5	52,0	30,06		NNW	2	Fine.
4	7 0	36,0	48,0	30,22		WNW	1	Fair.
	2 0	55,0	50,0	30,31		NW	1	Fine.
5	7 0	39,5	43,5	30,36		NE	1	Fine.
	2 0	58,5	55,5	30,42		NE	1	Fine.
6	7 0	50,5	52,0	30,18	0,039	NNE	1	Fair.
	2 0	57,5	55,5	30,08		NE	1	Rainy.
7	7 0	51,5	53,0	29,86	0,010	SE	1	Cloudy.
	2 0	60,0	57,5	29,90		SW	1	Rainy.
8	7 0	41,0	52,0	30,14		SSW	1	Fair.
	2 0	57,0	55,0	30,17		SW	1	Fine.
9	7 0	42,0	50,5	30,03		NE	1	Foggy.
	2 0	60,5	58,0	29,96		ESE	1	Fine.
10	7 0	54,0	56,0	29,82	0,266	WSW	1	Rainy.
	2 0	57,0	58,0	29,90		NW	1	Cloudy.
11	7 0	44,5	53,0	30,11	0,048	SW	1	Fair.
	2 0	61,5	57,0	30,08		SW	1	Fine.
12	7 0	58,0	57,0	29,91	0,030	SSW	1	Cloudy.
	2 0	64,0	59,5	29,91		SW	1	Cloudy.
13	7 0	55,0	60,0	30,00	0,075	WSW	1	Cloudy.
	2 0	64,0	62,0	30,00		SSW	1	Fair.
14	7 0	58,5	61,5	29,84		SE	1	Fair.
	2 0	63,0	63,0	29,70		SE	1	Cloudy.
15	7 0	50,5	60,0	29,69	0,010	SSW	1	Fair.
	2 0	62,0	62,0	29,67		ESE	1	Cloudy.
16	7 0	54,0	68,0	29,40	0,209	SSE	3	Much rain and wind last n.
	2 0	56,0	59,5	29,40		S by W	2	Showery.

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	Time.		Therm without	Therm. within	Barom.	Rain.	Winds.		Weather.
	H.	M.			Inches.	Inch.	Points.	Str.	
Oct. 17	7	0	47,0	55,0	29,68	1,070	SW	1	Fine.
	2	0	58,5	57,0	29,87		SW	2	Fine.
18	7	0	54,0	55,0	29,88		SSW	2	Cloudy.
	2	0	61,5	08,0	29,79		S by W	2	Fine.
19	7	0	56,0	58,0	29,59		S by E	1	Fair.
	2	0	64,5	02,5	29,64		SW	2	Cloudy.
20	7	0	50,0	58,5	29,69	0,050	SSW	1	Fair.
	2	0	58,0	59,0	29,84		WSW	1	Fine.
21	7	0	42,0	52,5	29,96		NE	1	Foggy.
	2	0	54,0	55,5	29,85		E by S	1	Rainy.
22	7	0	47,0	53,0	29,97	0,562	NNE	1	Fair.
	2	0	55,0	54,5	30,06		N by E	1	Fair.
23	7	0	47,0	51,5	30,14		N by E	1	Fair.
	2	0	57,0	53,5	30,14		NE	1	Cloudy.
24	7	0	54,5	54,5	30,18		E by S	1	Cloudy.
	2	0	60,0	56,5	30,17		SE	1	Cloudy.
25	7	0	54,5	60,0	30,15		SW	1	Fair.
	2	0	64,0	62,0	30,07		WSW	1	Fair.
26	7	0	57,0	59,0	29,95		WSW	1	Fair.
	2	0	61,5	62,0	29,91		WSW	1	Rainy.
27	7	0	53,0	58,0	29,89	0,134	WSW	1	Rainy.
	2	0	55,5	58,0	29,95		SW	1	Fine.
28	7	0	56,0	55,0	29,69	0,130	SW	2	Cloudy.
	2	0	57,0	57,0	29,68		SW	2	Rainy.
29	7	0	47,5	53,0	30,06	0,221	WSW	1	Fair.
	2	0	55,5	56,0	30,12		NW	1	Fine.
30	7	0	55,0	56,0	30,12		NNW	1	Fair.
	2	0	62,0	59,0	30,21		NW	1	Fair.
31	7	0	54,0	57,0	30,35		N by W	1	Fair.
	2	0	57,5	58,5	30,35		SW	1	Cloudy.

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	Time.		Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
	H.	M.			Inches.	Inch.	Points.	Str.	
Nov. 1	8	0	52,5	56,5	30,30		SE	1	Foggy.
	2	0	59,0	58,0	30,24		SSE	1	Cloudy.
2	8	0	50,0	53,5	30,09		NNE	1	Foggy.
	2	0	57,0	56,5	30,09		NW	1	Cloudy.
3	8	0	51,5	54,5	30,19		SSW	1	Fair.
	2	0	55,0	55,5	30,21		SSE	1	Cloudy.
4	8	0	55,0	56,0	30,10	0,020	SW	1	Cloudy.
	2	0	55,5	58,0	30,18		NW	1	Fine.
5	8	0	52,0	56,5	30,11	0,062	WSW	1	Rainy.
	2	0	56,0	57,0	30,11		SW	1	Cloudy.
6	8	0	46,5	54,0	30,21		WSW	1	Fair.
	2	0	53,5	55,0	30,22		NW	1	Fine.
7	8	0	50,0	43,5	30,20		W by N	1	Fair.
	2	0	69,5	65,5	30,18		NNW	1	Cloudy.
8	8	0	52,0	55,0	30,24		W by S	1	Foggy.
	2	0	55,0	55,5	30,24		NW	1	Cloudy.
9	8	0	44,5	53,5	30,33		W by S	1	Fair.
	2	0	52,0	53,5	30,38		NW	1	Cloudy.
10	8	0	45,5	51,0	30,25	0,264	NNE	1	Cloudy.
	2	0	46,0	50,0	30,28		NW	1	Cloudy.
11	8	0	46,0	48,0	30,10		W by N	1	Fair.
	2	0	50,0	50,0	30,07		NW	1	Showery and cloudy.
12	8	0	44,5	46,5	29,92		SW	1	Rainy.
	2	0	52,5	49,5	29,76		WNW	1	Showery.
13	8	0	43,5	47,5	29,56	0,100	NW	1	Fair.
	2	0	45,0	48,0	29,44		SW	1	Cloudy.
14	8	0	32,0	42,0	29,28	1,145	W by N	2	Fair.
	2	0	40,5	42,5	29,22		NW	2	Rain and snow.
15	8	0	36,0	40,0	28,99	0,122	WNW	1	Fair.
	2	0	38,0	41,0	29,00		SW	1	Cloudy and rain.
16	8	0	34,0	39,0	29,39	0,122	WNW	1	Fair.
	2	0	41,5	41,0	29,45		WNW	1	Rainy.

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	Time.		Therm. without	Therm. within.	Barom.	Rain.	Winds.		Weather.
	H.	M.			Inches.	Inch.	Points.	Str.	
Nov. 17	8	0	37,0	39,5	29,58	0,018	NNW	1	Cloudy.
	2	0	40,0	40,0	29,52		NW	1	Cloudy.
18	8	0	32,0	38,0	29,58		NE	1	Cloudy.
	2	0	37,0	38,5	29,62		NW	1	Fine.
19	8	0	30,0	37,0	29,64		W by N	1	Foggy.
	2	0	40,5	39,0	29,58		W by N	1	Fine.
20	8	0	32,5	37,0	29,46		SSW	1	Cloudy.
	2	0	37,0	38,0	29,29		SW	1	Cloudy.
21	8	0	35,0	36,5	29,09	0,160	NW	1	Cloudy.
	2	0	42,5	39,5	29,15		NE	1	Cloudy.
22	8	0	36,0	38,0	29,25		NNW	1	Cloudy.
	2	0	40,5	41,5	29,26		WSW	1	Fair.
23	8	0	29,0	36,5	29,20		SSW	1	Fair.
	2	0	34,0	37,0	29,22		SW	1	Fine.
24	8	0	34,0	35,5	29,38		W by S	1	Foggy.
	2	0	37,5	40,5	29,45		WSW	1	Foggy and fun-fhine.
25	8	0	36,0	36,5	29,15	0,245	ESE	1	Rainy.
	2	0	40,0	37,0	29,09		ESE	1	Cloudy and rainy.
26	8	0	43,0	38,0	28,75	0,237	W	1	Rainy.
	2	0	41,0	40,5	28,93		W	1	Cloudy.
27	8	0	33,0	38,0	29,03	0.044	ENE	1	Cloudy.
	2	0	59,0	38,0	28,92		NE	2	Rainy.
28	8	0	48,0	43,0	28,84	0,467	SSW	2	Fair.
	2	0	48,0	46,0	28,97		SSW	2	Rainy.
29	8	0	35,0	40,0	28,96	0,580	N by W	1	Rainy.
	2	0	43,0	43,0	29,22		NW	1	Fine.
30	8	0	37,0	42,0	29,20	0,189	W by N	2	Fair.
	2	0	45,0	44,0	29,78		SW	2	Fine.

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	Time. H.	M.	Therm. without	Therm. within.	Barom Inches.	Rain. Inch.	Winds. Points.	Str.	Weather.
Dec. 1	8	0	43,5	43,5	29,45		SW	1	Cloudy.
	2	0	48,0	48,0	29,51		SW	1	Cloudy.
2	8	0	55,5	49,5	29,26	0,236	SW	2	Rainy.
	2	0	58,0	52,0	29,24		SW	2	Rainy and windy.
3	8	0	53,5	55,0	29,29	0,253	W by N	3	Much wind and rain last n
	2	0	50,0	54,5	29,57		SW	2	Fine.
4	8	0	36,5	46,5	29,65	0,470	SW	2	Fair.
	2	0	42,0	47,0	29,85		SW	2	Fine.
5	8	0	33,0	42,0	30,07		NW	1	Fair.
	2	0	38,5	42,0	30,13		NW	1	Fine.
6	8	0	31,5	38,0	30,27		W by S	1	Foggy.
	2	0	35,0	45,0	30,29		SE	1	Foggy.
7	8	0	40,0	38,0	29,70		SSW	1	Cloudy.
	2	0	45,0	41,0	29,52		SW	1	Rainy and foggy.
8	8	0	40,0	43,0	29,67	0,722	NNE	2	Cloudy.
	2	0	39,0	42,5	29,88		NE	1	Fine.
9	8	0	36,5	38,5	29,85	0,047	SSW	1	Rainy.
	2	0	46,5	41,5	29,66		SW	1	Rainy.
10	8	0	47,0	46,0	29,75	0,439	S by W	1	Cloudy.
	2	0	44,0	47,5	29,75		SW	1	Rainy and cloudy.
11	8	0	47,0	49,0	29,75	0,110	SW	1	Cloudy.
	2	0	48,0	50,0	29,81		NW	1	Fine.
12	8	0	43,0	46,5	29,56	0,030	E	1	Rainy.
	2	0	50,0	48,0	29,45		NW	1	Rainy.
13	8	0	45,5	47,5	29,16	0,125	SSW	2	Cloudy.
	2	0	45,0	48,0	29,06		SSW	2	Rainy.
14	8	0	38,0	44,0	29,41	0,913	W by S	2	Fair.
	2	0	42,5	44,5	29,57		WSW	2	Fine.
15	8	0	34,0	40,0	29,91		S by W	1	Cloudy and foggy.
	2	0	37,0	41,0	29,88		S by W	1	Snow and foggy.
16	8	0	34,5	38,0	29,75	0,193	NE	1	Cloudy and foggy.
	2	0	41,0	40,0	29,64		NE	1	Cloudy and foggy.

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for December 1779.

	Time. H.	M.	Therm. without	Therm. within.	Barom. Inches.	Rain. Inch.	Winds. Points.	Str.	Weather.
Dec. 17	8	0	49,0	46,0	29,58	0,140	WSW	1	Foggy.
	2	0	53,0	58,5	29,60		WSW	1	Cloudy and rain.
18	8	0	51,0	50,5	29,62	0,398	SW	1	Cloudy.
	2	0	54,0	52,0	29,65		SW	1	Fine.
19	8	0	50,0	51,0	29,48	0,034	SW	2	Cloudy.
	2	0	52,0	53,0	29,47		SW	2	Cloudy.
20	8	0	48,0	52,0	28,91	0,201	SSW	2	Fair.
	2	0	50,0	52,5	28,85		SW	2	Fine.
21	8	0	44,0	49,5	29,00	0,179	SSE	1	Cloudy.
	2	0	49,0	50,5	28,91		SSE	1	Fine.
22	8	0	30,0	42,0	29,89	0,268	NNW	1	Fair.
	2	0	31,5	42,0	29,13		NW	1	Fine.
23	8	0	31,0	37,0	29,40		W by S	1	Frosty.
	2	0	34,5	38,0	29,43		SSW	1	Fine.
24	8	0	26,5	35,0	29,63		SSE	1	Foggy and frosty.
	2	0	31,0	35,5	29,64		NNW	1	Fine and frosty.
25	8	0	20,0	31,0	29,82		WNW	1	Frosty.
	2	0	28,5	31,5	29,88		NW	1	Fine and frosty.
26	8	0	20,0	28,0	30,04		W by N	1	Frosty.
	2	0	32,0	30,0	30,07		NW	1	Frosty and foggy.
27	8	0	33,0	32 0	29,98		NNE	1	Cloudy.
	2	0	35,0	33,0	29,91		NE	1	Foggy and snow.
28	8	0	36,0	35,0	29,81	0,095	NE	1	Cloudy.
	2	0	36,0	35,0	29,91		NE	1	Foggy and rain.
29	8	0	36,0	36,5	30,13	0,030	NE	1	Cloudy.
	2	0	38,0	36,0	30,19		NE	1	Cloudy.
30	8	0	35,0	36,0	30,30		ESE	1	Cloudy.
	2	0	47,0	37,0	30,33		SSE	1	Fine.
31	8	0	29,0	35,0	30,24		E	1	Foggy and frosty.
	2	0	34,0	36,0	30,26		E	1	Fine.

METE-

1779	Thermometer without.			Thermometer within.			Barometer.			Rain.
	Greateſt Height.	Leaſt Height.	Mean Height.	Greateſt Height.	Leaſt Height.	Mean Height.	Greateſt Height.	Leaſt Height.	Mean Height.	Inches.
January	50,0	25,0	37,2	48,5	31,5	38,2	30,61	29,63	30,24	0,216
February	60,5	37,0	47,9	53,5	44,0	48,8	30,53	29,84	30,26	0,239
March	73,0	33,0	49,2	56,0	35,0	48,1	30,63	29,63	30,19	0,523
April	78,0	38,0	53,8	64,0	47,0	54,8	30,59	29,43	29,96	1,224
May	82,5	41,5	58,4	79,0	45,0	59,4	30,27	29,51	29,89	1,708
June	75,0	52,5	61,7	69,0	51,5	64,0	30,22	29,48	29,92	2,476
July	85,0	57,0	68,0	81,0	63,0	69,5	30,42	29,30	29,91	6,401
Auguſt	84,5	55,0	67,4	79,0	62,0	69,4	30,29	29,64	30,05	1,074
September	79,0	52,0	63,4	78,0	58,0	65,3	30,20	29,54	29,87	2,232
October	64,5	36,0	54,2	68,0	43,5	56,8	30,42	29,54	29,96	3,031
November	69,5	29,0	44,2	65,5	35,5	45,5	30,39	28,75	29,62	2,778
December	58,0	20,0	42,1	58,5	28,0	42,0	30,33	28,85	29,50	4,883
Whole Year			53,9			55,1			29,43	26,785

VARIA-

VARIATION NEEDLE.

Month.	7 h. A.M.	12 h. M	2 h. P.M.	10 or 11 h. P.M.
	° ′	° ′	° ′	° ′
July 2	22 19	22 29	22 38	22 31
3	22 16	22 15	22 35	22 27
4	22 25	22 35	22 21	22 28
5	22 27	22 34	22 38	22 25
6	22 18	22 34	22 37	22 54
7	22 25	22 40	22 38	22 17
8	22 15	22 34	22 25	22 34
9	22 32	22 39	22 49	22 39
10	22 18	22 28	22 16	22 34
11	22 49	22 31	22 34	22 32
12	22 22	22 37	22 41	22 39
13	22 21	22 44	22 30	22 25
14	22 17	22 34	22 00	22 14
15	22 24	22 39	22 41	22 47
Means	22 21	22 34	22 32	22 31

Mean of all 22° 29′½.

Mean, allowing for the error of the inſtrument, *vide* vol. LXVI. p. 382. and vol. LXIX. p. 321. = 22° 28′.

Therefore, as the variation at the Society's houſe ſeems to be 15′½ greater than it ought to be by reaſon of the magnetiſm of the building (*vide* ſame place) the true variation ſeems to be 22° 4′½.

DIPPING NEEDLE.

Month.	7 h. A.M.	12 h. M.	2 h. P.M.	10 or 11 h. P.M.	Mean.	
	° ′	° ′	° ′	° ′	° ′	
July 2	72 30	72 45	72 45	72 45		
3	72 50	72 45	72 50	72 45	72 46	West marked end up.
4	72 50	72 45	72 45	72 50		
5	72 50	72 50	72 45	72 40		
6	72 50	71 55	71 50	71 55	71 55	East marked end up.
7	71 59	71 59	71 50	71 59		
8	71 59	71 50	72 0	72 10		
9	72 0	72 5	71 50	72 10	72 7	West marked end down.
10	72 10	72 10	72 10	72 10		
11	72 10	72 10	72 15	72 10		
12	72 50	72 40	72 40	72 40		
13	72 30	72 40	72 30	72 35	72 36	East marked end down.
14	72 50	72 50	72 10	72 30		
15	72 30	72 40	72 30	72 40		
					72 21	

THE END OF VOL. LXX. PART I.

APPENDIX.

I. *Tranſlation of a ſhort Extract from a Journal kept by* C. P. Thunberg, *M. D. during his Voyage to, and Reſidence in, the Empire of* Japan, *in a Letter addreſſed to the Preſident.* See page 143.

SIR,

DURING my ſhort reſidence in London, where you did me the honour of introducing me to many men of learning, converſations frequently aroſe, in which queſtions were aſked of me concerning the empire of Japan: to theſe I could at that time give anſwers only from memory; but, having now got poſſeſſion of my papers, I have drawn out, for the farther ſatisfaction of the Royal Society, and your particular friends, the following ſhort extract of a journal which I kept regularly during a reſidence of ſixteen months in that diſtant country.

To you, SIR, it is already known, that I was ſent out by the directors of the Botanic Gardens at Amſterdam, and ſome other eminent men of that place; firſt to the Cape of Good Hope, and from thence to Japan: in order to inveſtigate the natural hiſtory of thoſe countries, and to ſend from thence ſeeds and living plants of unknown kinds, for the uſe of their collections in Holland. At the firſt of theſe places I reſided three years; and during that time had the good fortune to obſerve and deſcribe many new ſpecies both of animals and vegetables.

In the year 1775 I ſailed from thence for Batavia, and after a ſhort ſtay there, embarked on board a Dutch ſhip, called Staveniſſe, bound for Japan, in company with the Blyenburg. On

the 21ſt of June, we ſailed and paſſed Pulo Sapatoo, the Coaſt of China, and the Iſland Formoſa. On the 13th of Auguſt we made the land of Japan, and the day after were off the harbour of Nagaſacci, the only one in that empire where foreign ſhips are allowed to anchor.

During this paſſage we met with ſevere gales of wind, in one of which the Blyenburg, having received much damage in her maſts, parted company, and (as we afterwards learned) was obliged to go back to Canton, to refit.

We ſailed into the harbour of Nagaſacci with our colours flying, and ſaluted the Papenburg, the Emperor's and Empreſs's guard, and the Town itſelf. During this time there came on board of us two Over Banjoſes, ſeveral interpreters, and inferior officers, and ſome people belonging to the Dutch Factory.

Theſe Over Banjoſes may be compared to the Mandarins of China: a place is prepared for them upon the ſhip's deck, and ſome of them (for they are frequently changed) muſt be preſent when any thing is taken out of, or received into, her. They inſpect every thing, muſter the people, give paſſports to ſuch as go on ſhore, and every day report to the governor of Nagaſacci the proceedings on board.

The attention and care with which theſe gentlemen execute the orders iſſued by the Imperial Court in 1775 is well worthy of relation. The moſt minute articles which are carried out of a ſhip undergo a jealous inſpection, both when they are put into the boats, and when they are landed from them; and the ſame caution is uſed in embarking goods from the ſhore.

Bedding is ripped open, and the very feathers examined. Cheſts are not only emptied of their contents, but the boards of which they are made are ſearched, leſt contraband goods ſhould be concealed in their ſubſtance. Pots of ſweetmeats and of butter are ſtirred round with an iron ſkewer. Our cheeſes had a more narrow inſpection; a large hole was cut into the middle of each, and a knife thruſt into the ſides of it in every direction: even the eggs were not exempted from ſuſpicion; many of them were broken, leſt they ſhould conceal contraband goods within them.

Ourſelves,

Ourſelves, from the higheſt to the loweſt, underwent the ſame ſuſpicious ſcrutiny whenever we went from or returned on board the ſhip. Our backs were firſt ſtroked down by the hand of the inſpector; our ſides, bellies, and thighs, were then in like manner examined; ſo that it was next to impoſſible that any thing could be concealed.

Formerly they were leſs exact in this viſitation; the chief of the factory and captain of the veſſel were even exempted from it. This priviledge they uſed in its utmoſt extent: each dreſſed himſelf in a great coat, in which were two large pockets, or rather ſacks, for the reception of contraband goods, and they generally paſſed backwards and forwards three times a day.

Abuſes of this nature irritated the Japan government ſo much, that they reſolved to make new regulations. For ſome time they found, that the more dexterity they uſed in detecting the tricks of the Europeans, the more dextrouſly they contrived to evade them: at laſt, however, by repeated trials, they have ſo compleatly abridged their liberties, that it is now almoſt, if not abſolutely impoſſible, to ſmuggle any thing.

The complexions of the Japaneſe are in general yellowiſh, although ſome few, generally women, are almoſt white. Their narrow eyes and high eye-brows are like thoſe of the Chineſe and Tartars. Their noſes, though not flat, are ſhorter and thicker than ours. Their hair is univerſally black; and ſuch a ſameneſs of faſhion reigns through this whole empire, that the head-dreſs is the ſame from the emperor to the peaſant.

The mode of the men's head-dreſs is ſingular; the middle part of their heads, from the forehead very far back, is cloſe-ſhaven; the hair remaining round the temples and nape of the neck is turned up and tied upon the top of the head into a kind of bruſh about as long as a finger; this bruſh is again lapped round with white thread, and bent a little backwards.

The women preſerve all their hair, and, drawing it together on the top of the head, roll it round a loop, and faſtening it down with pins, to which ornaments are affixed, draw out the ſides till they appear like little wings; behind this a comb is ſtuck in.

Phyſicians and prieſts are the only exception to the general faſhion; they ſhave their heads intirely, and are by that means diſtinguiſhed from the reſt of the people.

The faſhion of their cloaths has alſo remained the ſame from the higheſt antiquity. They conſiſt of one or more looſe gowns, tied about the middle with a ſaſh; the women wear them much longer than the men, and dragging on the ground. In ſummer they are very thin; but in winter quilted with ſilk or cotton wadding.

People of rank have them made of ſilk; the lower claſs of cotton ſtuffs. Women generally wear a greater number of them than men, and have them more ornamented, often with gold or ſilver flowers woven into the ſtuff.

Theſe gowns are generally left open at the breaſt; their ſleeves are very wide, but partly ſewed up in front, ſo as to make a kind of pocket, into which they can eaſily put their hands, and in this they generally carry papers, or ſuch like light things.

Men of conſequence are diſtinguiſhed from thoſe of inferior rank by a ſhort jacket of thin black ſtuff, which is worn over their gowns, and trowſers open on the ſides, but ſewed together near the bottom, which take in their ſkirts. Some uſe drawers, but all have their legs naked. They wear ſandals of ſtraw, faſtened to their feet by a bow paſſing over the inſtep, and a ſtring which paſſes between the great toe and that next to it, fixing to the bow. In winter they have ſocks of linen, and in rainy or dirty weather wooden ſhoes.

They never cover their heads but on a journey, when they uſe a conical cap made of ſtraw; at other times they defend themſelves from the ſun or the rain by fans or umbrellas.

In their ſaſh they faſten the ſabre, fan, and tobacco-pipe; the ſabre always on the left ſide, and (contrary to our European cuſtom) with the ſharp edge uppermoſt. Thoſe who are in public employments wear two, the one conſiderably longer than the other.

Their houſes are built with upright poſts, croſſed and wattled with bamboo, plaiſtered both without and within, and white-

waſhed. They generally have two ſtories; but the uppermoſt is low, and ſeldom inhabited. The roofs are covered with pantiles, large and heavy, but neatly made. The floors are elevated two feet from the ground, and covered with planks. On theſe are laid mats which are double, and filled with ſtraw three or four inches thick. The whole houſe conſiſts of one large room; but may be divided at pleaſure into ſeveral ſmaller, by partitions made with frames of wood, filled up with painted paper, that fix into grooves made for that purpoſe in the floor and cieling. The windows are alſo frames of wood, divided into ſquares, filled up with very thin white paper, tranſparent enough to anſwer tolerably well the purpoſe of glaſs.

They have no furniture in their rooms; neither tables, chairs, ſtools, benches, cup-boards, or even beds. Their cuſtom is to ſit down on their heels upon the mats, which are always ſoft and clean. Their victuals are ſerved up to them on a low board, raiſed but a few inches from the floor, and one diſh only at a time. Mirrors they have, but never fix them up in their houſes as ornamental furniture; they are made of a compound metal, and uſed only at their toilets.

Notwithſtanding the ſeverity of their winters, which oblige them to warm their houſes from November to March, they have neither fire-places nor ſtoves: inſtead of theſe they uſe large copper pots ſtanding upon legs; theſe are lined on the inſide with loam, on which aſhes are laid to ſome depth, and charcoal lighted upon them, which ſeems to be prepared in ſome manner which renders the fumes of it not at all dangerous.

The Portugueſe, in all probability, firſt introduced the uſe of tobacco into Japan: however, be that as it may, they uſe it now with great frugality, though both ſexes, old and young, continually ſmoke it, blowing out the ſmoke through their noſtrils. The firſt compliment offered to a ſtranger in their houſes is a diſh of tea and a pipe of tobacco. Their pipes have mouth-pieces and bowls of braſs or white copper. The hollow of the bowl is ſo ſmall as ſcarce to contain an ordinary pea. The tobacco is cut as fine as a hair about a finger's length, and is rolled up in ſmall balls like pills, to fit the ſmall hollow in the

bowl

bowl of the pipe; which pills, as they can laſt but for a few whiffs, muſt be very frequently renewed.

Fans are uſed by both ſexes equally, and are, within or without doors, their inſeparable companions.

The whole nation are naturally cleanly; every houſe, whether public or private, has a bath, of which conſtant and daily uſe is made by the whole family.

You ſeldom meet a man who has not his mark imprinted on the ſleeves and back of his cloaths, in the ſame colour in which the pattern is printed: white ſpots are left in manufacturing them, for the purpoſe of inſerting theſe marks.

Obedience to parents and reſpect to ſuperiors is the characteriſtick of this nation. It is pleaſing to ſee the reſpect with which inferiors treat thoſe of high rank: if they meet them abroad, they ſtop till they have paſſed by; if in a houſe, they keep at a diſtance, bowing their heads to the ground. Their ſalutations and converſations between equals abound alſo with civility and politeneſs; to this children are early accuſtomed by the example of their parents.

Their penal laws are very ſevere; but puniſhments are ſeldom inflicted. Perhaps there is no country where fewer crimes againſt ſociety are committed.

Their uſage of names differs from that of all other nations. The family name is never made uſe of but in ſigning ſolemn contracts, and the particular name by which individuals are diſtinguiſhed in converſation varies according to the age or ſituation of the perſon who makes uſe of it; ſo that ſometimes the ſame perſon is, in his life-time, known by five or ſix different names.

They reckon their age by even years, not regarding whether they were born at the beginning or the end of a year, ſo that a child is ſaid to be a year old on the new year's day next after his birth, even though he has not been born many days.

Commerce and manufactures flouriſh here, though, as theſe people have few wants, they are not carried to the extent which we ſee in Europe. Agriculture is ſo well underſtood, that the whole country, even to the tops of the hills, is cultivated. They trade with no foreigners but the Dutch and Chineſe, and in both caſes

with

with companies of priviledged merchants. The Dutch export copper and raw camphire, for which they give in return ſugar, ripe cloves, ſappan wood, ivory, tin, lead, tortoiſe-ſhell, chintzs, and a few trifles more.

As the Dutch company do not pay duty in Japan, either on their exports or imports, they ſend an annual preſent to the court, conſiſting of cloth, chintzs, ſuccotas, cottons, ſtuffs, and trinkets.

I had the ſatisfaction to attend the ambaſſador, who was intruſted with theſe preſents, on his journey to Jeddo, the capital of this vaſt empire, ſituated at an immenſe diſtance from Nagaſacci, a journey on which three Europeans only are permitted to go, attended by two hundred Japaneſe at leaſt.

We left our little iſland of Dezima, and the town of Nagaſacci, on the 4th of March, 1776, and travelled through Cocora to Simonoſeki, where we arrived on the 12th, and found a veſſel prepared for us; we embarked on board her, and coaſted along to Fiogo. From thence we travelled by land to Oſacca, one of the principal commercial towns in the empire. At this place we remained the 8th and 9th of April, and on the 10th arrived at Miaco, the reſidence of the Dairi, or eccleſiaſtical emperor. Here we alſo ſtayed two days; but after that made the beſt of our way to Jeddo, where we arrived on the 1ſt of May.

We were carried by men in a kind of palankins, called Norimons, covered, and provided with windows. The preſents alſo and our proviſions were carried on men's ſhoulders, except a few articles, which were loaded on pack-horſes. The Japaneſe officers who attended us provided us with every thing, ſo that our journey was by no means troubleſome.

On the 18th we had an audience of the Cubo, or temporal emperor, of the heir-apparent, and of the twelve ſenators; the day following, of the eccleſiaſtical governors, the governors of the town, and other high officers. On the 23d we had our audience of leave. We left Jeddo on the 26th of May, and arrived at Miaco on the 7th of June. Here we had an audience of the emperor's viceroy, to whom we alſo made preſents, as we were not allowed to ſee the Dairi, or eccleſiaſtical emperor.

On

On the 11th we procured leave to walk about the town, and visit the temples and principal buildings. In the evening we set out for Osacca, which town we were also permitted to view, which we did on the 13th.

We saw temples, theatres, and many curious buildings; but, above all, the manufactory of copper, which is melted here, and no where else in the empire.

On the 14th we had an audience of the governors of this town; after which we resumed our journey to Fiogo, where we again embarked on the 18th, and proceeded by sea to Simonoseki, from whence we arrived on the 23d at Cocota, and from thence were carried in Norimons to Nagasacci, and arrived at our little island Dezima on the last day of June, after an absence of one hundred and eighteen days.

II. *Tranſlation of an Eſſay written by the Abbé* Fontana, *on the* American *Poiſon called* Ticunas. See page 163.

THE experiments which I made at Paris during two years on the poiſon of the viper, and which are the ſequel of many others on the ſame ſubject, publiſhed in Italy ten years before, have enabled me to pronounce with ſafety on the nature and properties of that poiſon. The unexpected and important effects which I obſerved on the application of the poiſon of that animal to the bodies of living creatures, have led me to new diſcoveries in animal phyſics; and theſe diſcoveries have gradually led me to doubt of ſome certain medical theories, either not ſufficiently proved, or too generally applied by practitioners.

From that time I have been deſirous of extending my reſearches to other poiſons; and, if it had been poſſible, I could have wiſhed to examine ſome of the moſt active vegetable poiſons. I had imagined, the animal poiſons were like the poiſon of the viper, which freely diffuſes itſelf through the body of an animal when applied to a wound, but is not increaſed thereby in the manner in which the poiſon which produces the ſmall pox, or the canine madneſs, is augmented: I ſay, I conceived, that theſe poiſons might have much analogy to one another, and that they might act in the ſame manner, and upon the ſame parts of animals. On the other hand, I did not dare to conjecture any thing concerning the operation of vegetable poiſons, which I had not yet examined; nor did I think that any thing could ſafely be advanced concerning the action of them, even after the inſtructions derived from the beſt writers on them. Their manner of experimenting was very different from that which I had uſed in examining the poiſon of the viper, and their inferences appeared too vague and uncertain. Being arrived at London, however, I had it eaſily in my power to ſatisfy my deſires on this head. Dr. HEBERDEN, an eminent

phyſician there, and fellow of the Royal Society, procured me a great number of American arrows which had been carefully preſerved, and were well impregnated with poiſon. He was alſo ſo obliging as to ſupply me with a good quantity of poiſon, incloſed and ſealed up in an earthen veſſel incloſed in a tin caſe. Within the tin caſe was a paper containing the following words: "Indian poiſon, brought from the banks of the river "of the Amazons, by Don PEDRO MALDONADO: it is one of the "ſorts mentioned in the Phil. Tranſ. vol. XLVII. numb. XII." In the volume of the Tranſactions here quoted, mention is made of two poiſons little different in their activity; the one called the poiſon of Lamas, and the other of Ticunas. The poiſon contained in the earthen veſſel which I uſed is that of the Ticunas. It is not well known to which of the two the poiſon on the arrows belonged; but my experiments proved it was of the ſame ſtrength with that of the Ticunas, ſo that I do not think it at all material to diſtinguiſh the one from the other.

Much has been written by authors concerning the activity of theſe American poiſons; ſo that I thought it proper to make my experiments by degrees, and with all poſſible precaution. The very ſmell of them was thought to be noxious, on the bare opening of the veſſel; and if the leaſt of their particles was ſuffered to diffuſe itſelf through the air, ſome grievous diſorder, and even death itſelf, was apprehended; ſo, at leaſt, we read in the beſt authors. I began, therefore, as ſoon as the veſſel which contained the poiſon was open, by making a young pigeon breathe the air of it; for which purpoſe I held its head within the veſſel for a few minutes. On taking it out I found it as well as at firſt. I looſened with a pen-knife many pieces of the poiſon, in order to have a little duſt in the veſſel, and then again immerſed the head of the pigeon; but I found that in this ſecond experiment alſo the animal ſuffered nothing.

From that moment I made no more difficulty of expoſing myſelf to that vapour, and of ſmelling the effluvia, which ſeemed diſagreeable and nauſeous. Many of the particles entered my mouth with the air, and I found that they had a taſte ſomething like

like liquorice. The ſmell, therefore, of this poiſon, when dry, is perfectly innocent; as are alſo the particles which enter with the air into the mouth and noſe, and thence go to the lungs.

But the caſe in which it ſeems that this poiſon is moſt dreaded (although its application be ſtill external) is, when it is reduced to vapour or ſmoke by burning on the coals; or when, after boiling a conſiderable time, it riſes in denſe fumes. I wiſhed to try it in both theſe ways, and therefore threw many pieces of the dry poiſon upon burning coals, and cauſed the pigeon to breathe the fumes, by holding its head in the middle of them; but it never ſhewed any ſigns of ſuffering any pain. I went ſtill farther: I took a glaſs tube ſix inches long, and four wide, and filled it full of this denſe and white fume, and then introduced the ſame pigeon into it; but it ſhewed no more ſigns of ſuffering than if it had been held in the fumes of burning ſugar. I afterwards boiled a good quantity of it in an earthen veſſel. I expoſed the pigeon to the vapours both when the poiſon began to have ſome conſiſtence, and when, by more boiling, it began to burn to the ſides of the veſſel, and to be reduced into very denſe vapours, and to a coal; but ſtill the animal ſuffered nothing from theſe trials. I then made no ſcruple of freely ſmelling it and expoſing myſelf to the fumes of it. The odour of the dry poiſon, when burnt on the coals, is very diſguſting, and ſmells like burnt excrement.

From all theſe experiments I draw this concluſion, to wit, that the vapours or fumes of the American poiſon, when ſmelled or breathed, are innocent. Mr. DE LA CONDAMINE was certainly deceived when he wrote that this poiſon is prepared by women condemned to die; and that it is known to be come to its perfection when the vapours, which it emits in boiling, kill the perſon who is obliged to be preſent.

This poiſon diſſolves eaſily and very well in water, even when it is cold, and ſo it does alſo in the mineral and vegetable acids. But it diſſolves in oil of vitriol much more ſlowly than in the other acids, and becomes as black as ink by the operation, which it does not do with any of the other acids. It does not effervеſce with either acids or alkalies; neither does it alter milk, nor tinge it

except with its natural colour; nor does it tinge the vegetable juices, either red or green. When examined with the microſcope, there is no appearance of regularity or of cryſtallization; but it is for the moſt part made up of very ſmall irregular roundiſh bodies, like vegetable juices. It dries without making any noiſe, in which it differs from the poiſon of the viper, and it has an extremely bitter taſte when put upon the tongue.

From all which I deduce, that it is neither an acid nor an alkali, nor compoſed of ſalts that are viſible even with the microſcope.

It was not ſo much through curioſity as on account of the order which I had preſcribed to myſelf in making my experiments, that I was led to examine if this poiſon is fatal to life, when applied immediately to the eyes, or if it excites any diſeaſe or irritation of the parts. I had before found, that the poiſon of the viper was as innocent when put upon the eyes as it is in the mouth and in the ſtomach, whence I was curious to ſee the analogy between theſe two poiſons, both ſo active, and yet of ſuch different origins.

I began, therefore, by putting a ſmall quantity of it, diſſolved in water, on the eye of a Guinea-pig. The animal ſhewed no ſigns of ſuffering, neither at the time nor afterwards, nor was the eye in the leaſt inflamed. Two hours after, I repeated the experiment on both the eyes of the ſame animal, and with a greater quantity of the poiſon; but the pig did not feel the leaſt inconvenience, and the eyes remained in the natural ſtate. I tried the experiments on the eyes of two other Guinea-pigs with the ſame ſucceſs, which conſtantly attended all the experiments which I afterwards made on the eyes of many other animals, and eſpecially on thoſe of rabbits. I could never obſerve that it made any alteration in their eyes any more than if I had bathed them with pure water: from whence, I think, it may be concluded, that the American poiſon is not in the leaſt hurtful when applied to the eyes, and that it exerts no extraordinary action upon them.

But will it be innocent when taken in by the mouth and ſwallowed? Mr. DE LA CONDAMINE, and all others who have

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treated of this poiſon, believe it to be quite innocent when received by the mouth; and this is the common opinion of all the Americans. The reaſon they give for it is, that they can eat with impunity the animals killed with this poiſon, or rather with the poiſoned arrows. This reaſon is more ſpecious than convincing; ſince it may be a poiſon when introduced into the blood, even in the ſmalleſt quantity, and yet not be ſuch when taken in by the mouth, except the doſe be very conſiderably increaſed.

The following are the experiments which I have made, the reſult of which is to render us cautious of pronouncing, even after we have conſulted experience itſelf.

I made a young rabbit ſwallow two grains of the poiſon, diſſolved in water, and then forced it to drink a tea-ſpoonful of water, to waſh all the poiſon out of its mouth into its ſtomach. This animal ſhewed no ſigns of ſuffering either then or afterwards.

In like manner I made another young rabbit drink three grains of the poiſon, and it ſuffered nothing, any more than the former had done. I made another young rabbit drink four grains of the poiſon, and it likewiſe ſuffered nothing. I repeated the ſame experiments on three other young rabbits, to the laſt of which I gave ſix grains of the poiſon, but ſtill without any effect.

I then concluded that theſe experiments were ſufficient to aſſure me, that the American poiſon is innocent when taken by the mouth, as the poiſon of the viper is; but I was deceived. I had the curioſity to try it on a young pigeon, to which I gave ſix grains to drink, and it died in leſs than twenty minutes. I repeated the experiment on two other pigeons, and they both died within the half hour.

Theſe laſt experiments being contradictory to the former, obliged me to try ſeveral over again on the rabbits and on Guinea-pigs. I gave, therefore, to a ſmall Guinea-pig five grains of the poiſon to drink, and I found it dead after twenty-five minutes. I then made a young rabbit drink eight grains of the poiſon; at the end of the half hour it did not ſeem affected; but

but in half an hour more it tottered; four minutes after it fell down as if it were dead, and in four minutes more it was dead. I made two other young rabbits, and two other ſmall Guinea-pigs, drink nine grains of the poiſon: the two pigs died in twenty minutes, and one of the rabbits died in leſs than forty-five minutes. Theſe experiments induced me to believe, that a greater doſe of the poiſon may prove ſtill more certain death; and that the ſame quantity of poiſon produced different effects in the ſame animals, according to the ſtate their ſtomachs happened to be in at the time. I had generally obſerved, in making the experiments, that after ſwallowing the poiſon, thoſe animals which had their ſtomachs pretty full of meat either did not ſuffer any thing, or elſe died with much difficulty. I was deſirous of making this clearer, by experiments on three rabbits and two pigeons, which I therefore firſt kept for a long time without meat. Three grains of poiſon only killed each of them in leſs than thirty-five minutes. I repeated the experiment on five other animals with full ſtomachs, and only one of them died.

From hence I deduce this certain fact, that the American poiſon, when taken in by the mouth, is a poiſon; but that it requires a pretty large quantity of it to kill even a ſmall animal. The facts above related concerning the American poiſon, which is noxious when taken in large doſes, make me think, that the poiſon of the viper, although it is innocent when taken by the mouth in a ſmall quantity, may be mortal when taken in a greater quantity. That torpor which it excites on the tongue, and which continues ſo long, is enough to convince us, that it is not quite inactive, and that it may really be fatal when taken in a large quantity. I intend to try this experiment on ſome future occaſion, when I propoſe to give the collected poiſon of eighteen or twenty vipers to a ſmall animal when its ſtomach is empty, and I dare venture to prophecy, that it will die; for ſince a very ſmall doſe can take away motion and ſenſation from the tongue, or, in other words, deprive that organ of its principles of life, a greater quantity ought to deſtroy thoſe of the organs more eſſential to life itſelf. If we conſider that poiſon taken

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in by the mouth muſt extend itſelf over a very large ſurface which is always moiſt, and mix itſelf with the food in the ſtomach, and that the abſorbing veſſels are extremely ſmall, it will no longer ſeem ſtrange, that it is not noxious when taken in a ſmall quantity, which we have juſt ſeen to be the caſe with the American poiſon.

I began my experiments on the activity of this poiſon by wounding different parts of animals with a lancet wetted in the poiſon diſſolved in water. I wounded a ſmall Guinea-pig with it in the thigh three times at different intervals. The lancet was full of poiſon, yet the animal ſuffered no harm. I made the ſame trial on three other little pigs and a rabbit, but none of them either died or ſuffered any injury. In all theſe caſes the blood flowed evidently from the wounds: from which I ſuſpected that the poiſon could not diffuſe itſelf, but that it was driven back, as I had obſerved in the caſe of the poiſon of the viper, which, for this reaſon, is frequently harmleſs.

My ſuſpicion was ſoon confirmed by the following experiments. I ſoaked a ſingle thread in the poiſon, and paſſed it through the ſkin of a Guinea-pig near one of the nipples, but yet no diſorder followed. I then ſoaked another thread thrice doubled, and let it firſt dry a little, for fear the poiſon ſhould remain behind on the ſkin, in drawing the thread through it. I paſſed it through the ſkin of the thighs of a ſmall rabbit near the belly: in ſix minutes the rabbit began to ſhake and ſhew ſigns of weakneſs. In another minute it fell down motionleſs, appeared convulſed at intervals, and was quite dead in ſix minutes more.

I repeated this ſame experiment, of the ſoaked double thread, on two other rabbits, and on three Guinea-pigs; all of which fell down, and were convulſed in ſix or ſeven minutes, and died within the half hour.

I had the curioſity to try if the American poiſon could communicate itſelf to animals, and kill them, when applied to the ſkin barely ſcratched, or ſcarcely wounded with the point of a lancet.

I had obſerved at Paris, that the poiſon of the viper communicated a local diſorder in ſuch caſes, and that it affected and

disordered the skin, but did not prove fatal. The American poison, on the contrary, never produces any local disease, as I observed in making the experiments related above, but leaves the wounded parts as it found them. This constitutes an essential difference between these two poisons.

I clipped off the hair, with a pair of sciffars, from a part of the thigh of a small Guinea-pig, and scratched the skin lightly with a file. There was no visible discharge of blood; but certain small red spots and a moistness appeared on the skin. I bathed the part with a little drop of the poison dissolved in water. In ten minutes the animal gave signs of convulsions; a little after it fell down motionless, except convulsions, which it had now-and-then more or less strong, and it died in twenty minutes. The part of the skin where the poison had been applied was not at all altered. This experiment was attended with the same success on two other Guinea-pigs, and on a small rabbit; all the three dying in less than twenty-seven minutes with very evident signs of convulsions. I wished to try if the larger animals could resist this poison, when only applied to the scratched skin; and therefore, with the point of a lancet, I wounded, very lightly, in many places, the skin of a large rabbit, having first cleared the part of the hair, and then I bathed the wounded places with several drops of the poison. After fifteen minutes it became less brisk than before, and shook its head now-and-then, as if it could not hold it up without difficulty; but in twenty minutes more it became as lively as at first. I repeated the experiment on another somewhat smaller rabbit: in ten minutes it gave the same kind of shakes with its head, and could hardly go or support itself on its feet; but after other twenty minutes it was as lively as ever.

I shaved off about an inch of the skin of a pretty large rabbit; a little blood appeared although the flesh did not seem to be cut; I put about three drops of the poison on the place: in six minutes the rabbit seemed very faint; after another minute it fell down as if dead; it scarce breathed, and was at times convulsed; but in less than forty-six minutes it recovered the use of its

its feet, and a little after began to eat, and remained without any more ſigns of being diſordered.

I ſcratched the ſkin on the thigh of a hen, and applied the poiſon to it; but it continued well, although I repeated the experiments twice on other parts of the ſkin.

I ſlightly ſcarified the ſkin of a pigeon's thigh, and applied to it the poiſon diſſolved in water. After twenty-five minutes it was ſo weak that it could not ſtand, and was convulſed at intervals. It fell down a little after, as if it were dead, and remained in that ſtate of apparent death above three hours. By degrees, however, it began to recover, and in half an hour more it was quite well.

This experiment on pigeons was repeated five times. Three of them died in leſs than twenty minutes; and the other two were ſeized with convulſions, but afterwards they recovered.

From other experiments made afterwards, both on birds and beaſts, it may be concluded, that the American poiſon applied to the ſkin ſlightly ſcratched may be fatal, although it is not ſo always, nor in all circumſtances. The larger animals more eaſily reſiſt the action of the poiſon; and when the more feeble animals did not die, in a little time they were as well as ever.

I was deſirous to know what quantity of the poiſon was neceſſary to kill an animal. I had made a like inquiry concerning the poiſon of the viper, and had determined the quantity of that poiſon requiſite to kill the different animals. I might, indeed, have ſafely concluded, that a very ſmall quantity of the American poiſon is ſufficient to kill a ſmall animal, ſince one or two ſmall drops applied to the ſkin juſt ſcratched, had proved fatal to more than one; but I wiſhed for ſomething more poſitive.

I ſteeped a very ſmall bit of cotton into about one-fiftieth of a little drop of poiſon diſſolved, which could ſcarcely be the one-fiftieth part of the whole drop. This I introduced into a muſcle of the thigh of a pigeon, but the animal was not affected by it.

Two hours after, I put into another muſcle an atom of the dry poiſon, ſcarcely perceptible to the eyes: this likewiſe did not affect the pigeon. I repeated the experiment with the dry poiſon on three other pigeons, but none of them either died or

was ſick, though in one of the caſes the bit of dry poiſon was very perceptible. I made the ſame experiment on three Guinea-pigs, and on two ſmall rabbits, ſtill with the ſame ſucceſs, none of them being at all affected. It muſt be obſerved, the poiſon was not diſſolved by the humours of the wound, and I found the bits of it quite intire.

I put to the muſcle of another pigeon a bit of cotton much larger than before, impregnated with about eight times as much poiſon as in the former caſe: in ſix minutes time the pigeon fell down, and died ſoon after. To the muſcles of two Guinea-pigs I applied bits of cotton ſteeped in much the ſame quantity of poiſon as above: one of them died in twelve minutes, and the other fell down, as if dead, in ſix minutes, but it recovered a little time after.

From theſe experiments I conclude, that above one-hundredth part of a grain is requiſite to kill a ſmall animal; and that it is neceſſary that the poiſon be diſſolved, for it to prove fatal, or to cauſe any alteration in the animal oeconomy.

I have made various experiments to determine whether the American poiſon be fatal or hurtful when applied to the wounded combs of poultry, or to the ears of quadrupeds ſlightly wounded. The poiſon of the viper is not commonly fatal in theſe parts, nor is there any viſible diſorder in the poiſoned comb, though there is in the wattles, which ſwell horribly, ſo as ſometimes to kill the animal.

I wounded the comb of a fowl in many parts, and twice applied to it the American poiſon by means of cotton well ſoaked in it, but without being able to produce any diſorder. But the experiment ſucceeded better when tried on the ears. After having made many fruitleſs trials to communicate the poiſon by ſcratching or wounding the ears of many rabbits, all which ſhewed no ſigns of injury; I at laſt ſucceeded in killing two in leſs than thirty minutes by the application of a great quantity of the poiſon to the more fleſhy parts of the ears, which I had wounded in many places with the point of the lancet.

The experiments on the ears have evinced to me, that where there are few blood veſſels, either no diſorder is produced, or

elſe it is not mortal. In this reſpect the American poiſon has much analogy to that of the viper. As the poiſon of the viper is quite innocent when applied to the tendons and ligaments, eſpecially if they are without blood veſſels, ſo the American poiſon is equally innocent when applied to the ſame parts. It is ſuperfluous to relate the ſequel of theſe experiments.

I was deſirous of knowing whether the American poiſon were more ſurely fatal when introduced into the muſcles than when applied to the ſkin, though drawn through the latter from ſide to ſide. A large Guinea-pig, which two days before had twice undergone the operation of the ſkin cut, without ſuffering any diſorder, and a third time with but little ſigns of being affected, died in leſs than twelve minutes after I had applied the poiſon to the wounded fibres of a muſcle of its thigh. It fell down motionleſs after the firſt three minutes. I repeated the experiment ten times on Guinea-pigs, pigeons, and middle-ſized rabbits, and all the animals died; ſo that there can be no doubt but that poiſoned wounds in the muſcles are more fatal than thoſe in the ſkin, or in the ears, or in the combs of fowls. The more certain method, however, of ſucceeding is, to ſoak well a piece of very porous wood, cut very ſharp, in the poiſon, and ſo introduce it into the ſubſtance of the muſcle laid bare for that purpoſe. But even this method failed three times that I tried it on the combs of fowls: nor did I ever obſerve any appearance of diſorder, although the wood was well ſoaked, and although I left it for ſeveral hours in the combs.

On this occaſion I made uſe of the arrows; many of which I employed in perforating the ſkin of animals, and many others in piercing the muſcles. All the animals, eſpecially the larger rabbits, which were wounded in the ſkin, did not die, though the greateſt part of them did; but none of thoſe recovered which were pierced in the muſcles. In general, I found that the arrows are more dangerous, and oftener fatal, than the poiſon diſſolved in water, and then ſimply applied to the wounded parts. I found the poiſon on the arrows more active after ſteeping

them in warm water, as they then operated both more ſpeedily and more ſurely; and their activity is ſtill more increaſed by ſoaking them in the poiſon, boiled in water to the conſiſtence of julep. Various large animals, ſuch as rabbits, have fallen down motionleſs in this manner in leſs than two minutes; and ſome of the ſmaller ſort have been viſibly affected in leſs than one minute.

I introduced one of the arrows, that had been well ſoaked in the boiled poiſon, into the comb of a fowl, and left it there a whole day, without any appearance of injury to the animal. The next day I perforated the comb and the wattles with two arrows prepared as before, and left them there for ten hours; but ſtill without any effect. I then perforated one of the muſcles of the thigh with an arrow, and the animal died in forty-two minutes.

I had propoſed to myſelf, amongſt other things, to examine what alteration this poiſon may undergo by uniting it with acids and with alkalies. This I had tried with the poiſon of the viper, the noxious qualities of which neither the moſt powerful mineral acids, nor the moſt active alkalies, could take away. For this purpoſe then I diſſolved the poiſon in three mineral acids, as alſo in diſtilled vinegar, and in rum; and about an hour after I made the following experiments.

I made ſome ſmall gaſhes in the ſkin of a ſmall Guinea-pig, and covered it over ſeveral times with the poiſon diſſolved in the nitrous acid: the animal appeared to ſuffer nothing but the mechanical inconvenience of the wound and the acid; within an hour after it was as lively as ever. Two hours after I repeated the experiment on another part of the ſkin prepared as above, which I covered with the poiſon diſſolved in rum; the animal died in leſs than four minutes.

I ſlightly wounded the ſkin of a young rabbit, and applied to it many drops of the poiſon diſſolved in oil of vitriol: it ſeemed to ſuffer nothing, and was as lively as before. Four hours after I prepared another part of the ſkin as above, and applied to it a few drops of the poiſon diſſolved in diſtilled vinegar: the animal fell down after four minutes, and was quite dead in ſix.

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I prepared, likewiſe, the ſkin of another ſmall rabbit, and covered it with the poiſon diſſolved in the marine acid; but the animal was not affected. Six hours after I applied the poiſon, diſſolved in rum, to another part of the ſkin, and in forty-five minutes it fell, and was convulſed; but it recovered in leſs than an hour.

From theſe firſt experiments it ſhould ſeem, that mineral acids render the poiſon innocent; and that, on the contrary, vinegar and rum make no alteration in it. I continued my experiments with the poiſon diſſolved in vinegar and in rum, but the reſults were ſomewhat various. Of ſix animals, to which was given the poiſon diſſolved in vinegar, only two died; two others were very ſick, and the remaining two were not at all affected. Of ſix others, treated in like manner, with the poiſon diſſolved in rum, five died; and the ſixth was very ſick. From hence it appears, that the poiſon diſſolved in theſe two fluids preſerves its noxious quality.

On the other hand, I repeated the experiments with the poiſon diſſolved in mineral acids on ſix animals; and not one of them was in the leaſt affected. I began to ſuſpect, that the poiſon might fail in its effect, not becauſe it had loſt its noxious quality, but becauſe it could not inſinuate itſelf into the wounded parts, on account of the too great action of the mineral acids on the ſkin and veſſels, which they ſhrivel and burn up. To clear up this doubt, I evaporated by heat the poiſon diſſolved in the mineral acids, and, when it was quite dry, applied it many times to ſeveral animals in various parts of their ſkin; but none of them were hurt by it.

It appears, therefore, that the mineral acid deſtroys the noxious quality of the American poiſon: I only ſay, *it appears*, becauſe it may, perhaps, be ſuſpected, that, as there remained a little of the acid mixed with the poiſon after evaporation, it was this that produced the uſual alteration in the veſſels of the ſkin. I ought to have made ſome other experiments with it waſhed ſeveral times in water, and rendered quite inſipid; but at that time I was in want of animals to aſcertain the truth of this ſuſpicion, and I have not had time ſince to reſume the ſubject.

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With reſpect to the alkaline ſalts, I may ſay, that I have not diſcovered that they alter the poiſon, or render it in the leaſt leſs noxious. It is true, indeed, that I have not ſo often repeated the experiments, nor ſo much varied them, as I ought to, and as I ſhould have done, if I had not found a great difficulty in procuring animals, and if I had not had in view other experiments much more important.

It was natural for me to think, that as the acids hinder the action of the poiſon on animals, they might alſo be a remedy againſt that poiſon.

I prepared, therefore, in the uſual way, the ſkin of a Guinea-pig, and covered it with the poiſon; and about forty ſeconds after I waſhed it with the nitrous acid and afterwards with pure water: the animal ſuffered nothing. Two hours after I introduced the poiſon into a muſcle, and immediately applied the nitrous acid to the part; but the animal fell in a moment convulſed, and was quite dead in two minutes.

I repeated this experiment on the muſcles of another Guinea-pig, and as ſoon as I had applied the poiſon, waſhed it with the nitrous acid, and a little after with water. It fell convulſed in two minutes, and was quite dead in four.

I poiſoned, in like manner, the muſcles of four pigeons, and the moment after I waſhed them with the nitrous acid: they died in one minute. Suſpecting that it might be owing to the nitrous acid rather than to the poiſon, I next made uſe of nitrous acid, much diluted, on four other pigeons; but they all four died, although much more ſlowly. Being deſirous of knowing whether the ſimple application of the nitrous acid to the muſcles could kill pigeons and ſmall Guinea-pigs, I made the trial on two of each ſort: the pigeons both died ſoon after; but neither of the pigs, although one of them was very ſick.

It appears, therefore, that acids are not only uſeleſs as a remedy; but ſometimes dangerous, when applied to the poiſoned muſcles of animals.

I ſhall not ſay any thing of any other remedy which I have tried, becauſe I have found by experience that they are all uſeleſs, whether they are applied ſoon or late, or whether externally

nally or internally. When the poiſon is introduced deeply, and has already inſinuated itſelf into the humours, every remedy comes too late and is uſeleſs.

There yet remained to be made a further very nice inquiry, and which might in ſome caſes too have turned out a very uſeful one. My experiments on the poiſon of the viper led me to make an obſervation of the ſame ſort on the American poiſon. I had determined from them the time which the poiſon of the viper employs in diffuſing itſelf into the body of the animals; and when it might be uſeful to cut away the poiſoned part, or to make a ligature about it, to hinder the poiſon from communicating itſelf to the animal by the blood.

I introduced into the muſcle of a pigeon's leg an American arrow ſteeped in warm water, and left it there; and four minutes after I made a ligature moderately tight, immediately above the wound. In twenty-ſix hours the animal ſeemed to ſuffer no inconvenience but from the ligature. I then withdrew the arrow, and looſed the ligature. The part was a little ſwelled and livid; but the animal did not die of it, though it could make no uſe of its leg for many days, and afterwards uſed it with ſome difficulty.

I pierced the muſcles of another pigeon with a freſh arrow, as above, and applied the ligature ſix minutes afterwards, leaving the arrow in the wound. In four minutes the pigeon had not ſtrength to hold up its head, or ſcarcely to ſtand; preſently after it fell down to all appearance dead, and was quite dead in ſix minutes more.

I repeated the experiment on another pigeon, leaving the arrow in the muſcles again, and eight minutes after I tied the bandage about the leg. Three minutes after it was viſibly ſick, but recovered again a little afterwards. It was ſtill living twenty-ſix hours after, although the muſcles were livid. I then looſed the bandage, and it died in two hours.

I ſubjected a fourth pigeon to the ſame experiments, leaving the arrow in the muſcles, and applying the bandage five minutes after: it died in two hours.

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I performed the ſame experiments on four other pigeons, to all of which I applied the bandage in two minutes. Ten hours after they were all living; I then took off the bandage, after which three of them died, and the fourth recovered perfectly.

I again repeated the ſame experiments in like manner on other four pigeons, but left the bandage on thirty hours: only one of them died, and that was not till two days after, and certainly from the effect of the bandage being too tight, which had produced a gangrene in the muſcles. Theſe ſame experiments I have alſo repeated on much younger pigeons, whoſe legs may be cut off below their thighs without their dying. None of thoſe died whoſe legs were cut off two minutes after they were poiſoned; and only two out of ten died of thoſe whoſe legs were cut off after three minutes. Fewer pigeons died by this method than by the bandage, when they were both applied after equal times. The reaſon of this is, that the amputation is not attended with death or any remarkable diſorder in the animals, whereas the bandage often produces the gangrene in the parts wounded by the arrows, and the pigeons frequently die of the gangrene. I made alſo the ſame experiments on ſome ſmall Guinea-pigs, and on many young rabbits, ſometimes cutting off the part, and ſometimes applying the bandage. The reſults were in general ſimilar to thoſe obſerved in the pigeons, although not quite ſo regular or certain.

In general I found, that it required a certain time for the American poiſon to communicate itſelf to animals, that this time is much greater than that which the poiſon of the viper requires to communicate itſelf, and that the effects of the American poiſon on animals are more vague and more various; and that, finally, animals may be cured of the effects of both theſe poiſons by cutting away the part in time, when it can be done without endangering the life of the animal by the operation itſelf.

In the courſe of my experiments on the poiſon of the viper, I found that it is not poiſonous to all animals; and that there are ſome cold-blooded animals to whom it is quite innocent. I was

curious

curious to know if the caſe was the ſame with the American poiſon. All the writers on the American poiſon tell us, that it is poiſonous to all animals; but aſſertions are very different from facts. Many experiments are neceſſary to evince this general concluſion, and it does not appear that enough have been made to warrant it.

I began by impregnating the muſcles of frogs with the poiſon, and they died in a little time. I then had recourſe to eels, into which I introduced the arrows, towards the lower or tail parts of them; and they all died, though very ſlowly.

I had found that the poiſon of the viper is quite innocent to the viper itſelf, and to thoſe ſerpents which in Tuſcany are called *binchi*, and by the French, *couleuvres*. Of theſe laſt I could procure no more than two; for which reaſon I could make but few experiments on them; but thoſe I have made I think quite deciſive. I wounded one of them towards the tail with an arrow well covered with poiſon of the thickneſs of ſyrup, and left the arrow in the muſcles. I had previouſly made an inciſion in the place where I introduced the arrow, that the diſſolved poiſon upon the arrow might likewiſe eaſily enter the muſcles with the arrow. I alſo applied ſome more poiſon to the ſame part by means of ſmall inciſions in the muſcles. The ſerpent did not ſeem affected by the poiſon; but for many hours was as well as ever. I locked it up in a box, which having opened ſix hours after, I found that the ſerpent was gone, nor could I ever find it again.

I repeated the experiment many times, at different intervals, on another rather ſmaller. The laſt time I introduced two poiſoned arrows into the muſcles of the tail, and left them there for twenty-four hours. I frequently applied the poiſon thickened to a ſyrup to the wounds, and introduced a great quantity into them with a tooth-pick, yet, ſo far from dying, the animal was not ſenſibly hurt.

I have often made this ſame experiment on vipers, without any one of them dying by the poiſon, although ſome were wounded in the muſcles towards the tail with many arrows well impregnated with poiſon thickened to a ſyrup. I have

left the arrows for twenty or thirty hours together in the muſcles, and yet none of them have died. It is true, indeed, that ſome few, after being operated on, appeared leſs lively than before; and it ſeemed, that the wounded parts, or the lower half of the body, had ſenſibly loſt ſome of its natural motion, and this torpor continued in ſome for many hours; but then again others continued as lively as before.

After all theſe experiments it may be ſafely aſſerted, that the American poiſon is intirely innoxious to cold-blooded animals, as is the poiſon of the viper; in which reſpect theſe two poiſons have a great analogy, although the one be no more than an animal gum, as I have ſhewn elſewhere, and the other a mere vegetable juice.

It remained to examine the action of this poiſon on living animals; and alſo which are the particular parts of animals that are affected by it when it proves fatal.

Every thing tended to make one think, that it excites one of thoſe diſorders which modern phyſicians call nervous. The ſymptoms are preciſely and deciſively the ſymptoms of thoſe diſeaſes. Convulſions, faintneſs, a total loſs of ſtrength and motion, a diminution or intire want of ſenſation, are the ordinary ſymptoms of the poiſon, in animals. It has often been obſerved, that very lively animals become in a moment ſenſeleſs and motionleſs, and ſeem at the point of death. I have generally obſerved a ſymptom which ſeems to be a real demonſtration that the diſorder produced by this poiſon is purely nervous. If the animals do not die in a few minutes, they perfectly recover again, although they have been thrown into a ſtate of lethargy often for hours, and have not given any certain and evident ſigns of life. Now this is the very caſe with the diſorders which are called nervous. They frequently come on at once; they ſometimes excite convulſive motions, and ſometimes they deprive the patient of all ſtrength; but as ſoon as the effects of the diſorder ceaſe, the patient becomes perfectly well, and is hardly ſenſible that he has been ill. Notwithſtanding all this, theſe ſigns could not impoſe on me after my experiments on the poiſon of the viper: for the diſorder produced by that poiſon

has alſo ſome ſymptoms of the nervous diſorders, and it appears that the nerves are chiefly affected, although experiments have determined the contrary: therefore, we ought here alſo to have recourſe to experiments, and not ſuffer ourſelves to be ſeduced by an unfounded theory, and by ſpecious reaſonings.

To proceed methodically in this important queſtion, I thought it would be proper to begin by examining whether the American poiſon produces any ſenſible alteration in the blood drawn from the veins of animals, when it is mixed with it.

I cut off the head of a pigeon, and received its warm blood into two warm conical glaſſes, to the amount of about eighty drops into each. Into the one glaſs I put four drops of water, and into the other four drops of the poiſon, diſſolved in water as uſual; the quantity of poiſon in theſe four drops ſcarcely amounting to one grain in weight when dry. I ſtirred round equally the contents of the two glaſſes for a few ſeconds, in order to mix the materials well together. In two minutes the blood which was mixed with the pure water was coagulated; but the other blood which was united with the American poiſon never coagulated, but became darker and blacker than the former, which remained red as uſual. Three hours after it was ſtill as fluid as at firſt, while in the other glaſs the ſerum appeared to be already ſeparated from the red part.

I examined the blood of both the glaſſes with a microſcope, both at that time and afterwards, and found that the red globules ſtill preſerved their original figure, and that there was no difference between the two in this reſpect.

I repeated this experiment many times with the ſame ſucceſs; ſo that it is evident, that the American poiſon does not ſenſibly alter the red globules of the blood in the circumſtance above mentioned. It is, however, worthy of obſervation, that this poiſon is ſo far from coagulating the blood, that it abſolutely prevents the coagulation which happens in the blood after it is drawn from animals; yet it cannot be ſaid to attenuate or diſſolve the blood, ſince nothing of that kind is obſerved when it is examined with a microſcope, the red part remaining figured as in its

natural ſtate, and nothing more ſubtle or more thin being obſervable in that fluid.

A circumſtance perfectly ſimilar I alſo obſerved to happen with the poiſon of the viper; ſo that the effects or alterations cauſed by theſe two poiſons in the blood drawn from the veſſels, appear to be perfectly ſimilar, both of them hindering the blood from coagulating, yet neither of them diſſolving or altering the globules of it: the only difference between them is, that the poiſon of the viper tinges the blood much blacker than the American poiſon does.

The poiſon of the viper does not alter the globules of the blood even when it is given to the living animal, and that the animal in conſequence dies. I have obſerved the ſame thing with reſpect to thoſe animals which are killed by the American poiſon; ſo that the two poiſons agree in a wonderful manner in all theſe caſes. But as the poiſon of the viper produces in general a ſenſible alteration in the maſs of the blood of thoſe animals that are bit by it; I thought that the ſame attention ought to be paid to the examination of the blood of thoſe animals which have died of the American poiſon.

I have obſerved in general, that the muſcles of animals killed by the American poiſon were paler than before; the blood veſſels near the heart appeared more turgid than uſual; the blood a little darker coloured than ordinary, though not much, nor coagulated; the viſcera of the abdomen not ſenſibly affected; the heart and the auricles in the natural ſtate, although the heart had ſometimes its external veſſels more viſible, and that they appeared as if they were injected.

But I have obſerved a great alteration in one of the viſcera, the moſt eſſential to life, to wit, the lungs, which always appeared greatly affected. I have generally found them ſpotted more or leſs; often with large and livid ſpots, and ſometimes they ſeemed to be quite putrified. This effect on a viſcus ſo eſſential to life deſerves the greateſt attention: it appeared to me, that it was the greater the longer the animal had lived after being poiſoned. I have obſerved the lungs of ſome animals to

be here and there tranſparent, eſpecially towards the edges. The pulmonary air was very viſible through the external membrane: I have examined it with a microſcope, and have been able to diſtinguiſh very well the ſmall pulmonary bladders, ſtreaked with veſſels for the moſt part without blood.

Great as this alteration is in ſo important a viſcus, I could not perſuade myſelf, that it could alone produce ſo great and inſtantaneous a diſorder, and that the whole force of the poiſon exerted itſelf only upon the blood and lungs. There was, indeed, the inſtance of the poiſon of the viper, which produces ſomething ſimilar; but then this poiſon produces a kind of general coagulum in the blood itſelf, which certainly is not obſervable from the American poiſon.

In an inquiry ſo important, and at the ſame time ſo obſcure, I thought I ought to have recourſe to experiment itſelf, and to examine the effects of the American poiſon when introduced immediately into the blood. For this purpoſe I made uſe of the ſame method which I had before employed for introducing the poiſon of the viper into the blood of the jugular. I uſed a turn-cock of glaſs, bent at the point, inſtead of a ſmall ſyringe. With this cock I took up the American poiſon diſſolved in water, and then opening the jugular vein thruſt the point into it. As the method of making this ſort of experiments has been before deſcribed in my treatiſe on the poiſon of the viper, I think it unneceſſary to give a particular deſcription of it here. The experiment is ſo conducted, that the poiſon enters the blood by the jugular without touching any cut part of the veſſels, not even thoſe of the jugular itſelf.

For the firſt experiment I put into the glaſs ſyringe four drops of the poiſon diſſolved in water; the quantity of poiſon in the four drops could hardly amount to half a grain. I introduced the crooked end of the ſyringe into the jugular of a large rabbit; but in the act of puſhing in the piſton, which was not cloſe enough fitted to the bore of the ſyringe, the poiſon returned backward, which made me ſay to the perſons who were preſent, that the experiment had failed; but I was ſurprized when they anſwered me, that the animal was already dead. I believe there

were

were not ten ſeconds between the moment in which I ſaw the poiſon turned back, and that of my being told that the animal was dead, as in fact it was. I cannot ſay what quantity of poiſon was introduced into the blood; there muſt have entered a ſufficient quantity, as the animal was killed; but had it not been for that circumſtance, I ſhould have judged, from the quantity returned back, that none at all had entered the jugular. The animal was ſo dead, that there appeared no ſigns of reſpiration, and the whole body was more pendent and flaccid in all its parts than is uſual with animals that have been long dead. The death of this animal followed ſo cloſe upon the introduction of the poiſon, that the interval of time ſeemed quite inſenſible: it appeared to take place much quicker than in the caſe of the poiſon of the viper, introduced into the blood in the ſame manner.

Having repaired my ſyringe, I put into it only two drops of the water in which I had mixed one quarter of a drop of the poiſon diſſolved in water as above. I had ſcarcely introduced the poiſon into the jugular, when the rabbit fell down as dead as if it had been ſtruck with lightning. I do not believe that half a drop of the liquor in the ſyringe was introduced when the animal fell motionleſs and dead.

In general, from other experiments which I made afterwards, I think I may venture to ſay, that this poiſon, introduced immediately into the blood by the jugular, kills ſooner, and requires a leſs quantity of it to kill than the poiſon of the viper does. Death follows the introduction of the poiſon into the blood ſo ſpeedily, that it prevents the uſual convulſions of the animal. If a ſmaller quantity of the poiſon be taken, we then perceive the ordinary convulſions and palpitations, and death does not happen ſo ſuddenly.

It is indeed true, that the blood is not coagulated, nor ſo much altered in its colour, as when the poiſon of the viper is introduced into the jugular; but death is not, therefore, more tardy, nor leſs certain, as both the poiſons, when introduced immediately into the blood, kill animals in the ſame manner.

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This then is a truth gained from experiment, to which nothing can be objected, however dark or little underſtood the cauſe of death may be in ſuch caſes: viz. that the American poiſon, introduced into the blood, kills the animal inſtantaneouſly; from whence alſo it indubitably appears, that when it is externally applied to a wounded part of a living animal, it can and ought to communicate, by means of the blood, a great diſorder into the animal oeconomy, and occaſion death itſelf. The death of the animal, which follows the inſtant that the poiſon is introduced into the blood by the jugular, proves to a demonſtration, that in ſuch caſes all the action of the poiſon is againſt the blood itſelf, and that the nervous ſyſtem is not at all affected or altered. This, however, is ſtill no proof that the nerves may not be more or leſs affected by that poiſon, when death happens much ſlower, and when it is applied externally to wounded parts. In this caſe we perceive the convulſions, and all the ſigns of a nervous diſorder. The nerves may, therefore, probably be affected by the poiſon, and be the chief cauſe of the death of the animal.

We muſt here, however, ſtill have recourſe to direct experiment, as was done with reſpect to the poiſon of the viper, and ſee what diſorders and diſeaſes are produced by the American poiſon when applied immediately to the nerves without touching the veſſels.

My experiments have been made on the ſciatic nerves of large rabbits, which I prepared in the ſame manner as I had done at Paris, when I was making experiments with the poiſon of the viper, ſo that I ſhall not here give any particulars concerning the method of preparing theſe nerves. I ſhall mention, however, a ſmall number of the principal experiments made on the nerves, by which may be ſeen the variety of ſucceſſes I met with, eſpecially in the firſt trials, which would have deceived me if I had not perſiſted in multiplying my experiments, and varied them in proportion as I found leſs agreement in the reſults. To this perſeverance, or obſtinacy as I may call it, I chiefly owe the new diſcoveries which, I believe, I have made concerning the two poiſons of the viper and the Ticunas.

Having

Having laid bare the ſciatic nerve of a rabbit, I paſſed under it a fine rag ſeveral times doubled, and put upon the nerve a little cotton well ſoaked in the American poiſon, thickened to a ſyrup. I covered the nerve with the ſame rag, that the poiſon might not run over the opened muſcles of the animal, and ſewed up the ſkin as uſual. After ten minutes the rabbit began to have convulſions, and to totter; it then fell with all the ſigns accompanying the effects of the poiſon, and died ſoon after.

I repeated the ſame experiment on another rabbit, and took care to wrap up the poiſoned nerve with rags ſtill better than before. This ſecond rabbit ſhewed no ſigns of being affected for ten hours, during which I obſerved it; but looking at it after two hours more, I found it had been dead a little while, as it was ſtill warm.

I ſuſpected that the poiſon applied to the nerve, which was conſiderable in quantity, might at length have penetrated through the rags, and uniting with the humours of the parts cut, have extended its action to the muſcles and the adjacent parts. I was under the neceſſity, therefore, of either diminiſhing the quantity of poiſon, or increaſing the rags, to prevent any diffuſion of the poiſon through them: I adopted the latter as the more ſecure way.

I detached the ſciatic nerve of a rabbit as uſual, and introduced below it a very fine rag, often doubled. I put the bit of cotton, well ſoaked in the poiſon, on the nerve, and covered every thing well with the lappets of the rag. This rabbit lived twenty-four hours, and only ſhewed ſigns of being ill in the laſt hour, nor was there any reaſon to think that it died of the effects of the poiſon.

I prepared the ſciatic nerve of another rabbit in the ſame manner, covering it with the poiſon and rags as before. This rabbit died forty hours after, without any ſymptoms of being poiſoned.

I made the ſame experiment on the ſciatic nerve of three other rabbits, having taken all poſſible care that the poiſoned nerve ſhould be well covered with rags, that there might not be any reaſon to ſuſpect the poiſon might penetrate through them.

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One of them died three days after, but the other two were ſtill living at the end of eight days.

I alſo prepared the nerves of two other rabbits exactly as above, but without the poiſon, to ſerve as a kind of comparative experiment to the former. One of theſe rabbits died in thirty-ſix hours, and the other was ſtill living eight days after.

Theſe experiments ſeemed ſufficient ground to determine, whether the American poiſon, when applied externally to the nerves, is capable of producing any malady or diſorder in animals. But it remained to be tried, whether it be equally inactive when applied to wounded nerves, as alſo to the pulp of the nerves.

I prepared the ſciatic nerve of a rabbit as above, and I pierced it ſeveral times through with a lancet, before I applied the poiſon to it, and then put the poiſon exactly upon the wounded part of the nerve. The rabbit lived five days, and then died without any apparent illneſs. I repeated the experiment on another rabbit with the ſame circumſtances, and it was ſtill living eight days after.

I varied the experiment a little on the nerves of three other rabbits. Inſtead of wounding the nerve in many places, I made an inciſion, above five-twelfths of an inch long, into it, and introduced into the ſlit ſome threads, well ſoaked in the poiſon, and covered the whole up very well. One of theſe died in ſixty hours, but ſeemingly not from the poiſon; the other two were living eight days after.

I thought it neceſſary to vary alſo this ſecond kind of experiment, and to cut the nerve as I had done in examining the poiſon of the viper. In conſequence I cut the ſciatic nerve as far as I could from the top, to be able eaſily to wrap the rags about it. The detached part of the nerve in the largeſt rabbits might be about an inch and a half. Having placed the nerve on the rags I covered it well with poiſon in the part where it was cut, and covered the whole up with the rags as uſual.

I performed this experiment on ſix rabbits. Two of them died in forty hours; two others in three days; but the remaining two were living four days after.

For a comparative experiment I prepared, as above, the nerves of two other rabbits, which I cut, but did not apply the poiſon to: one of them died in thirty-ſix hours, but the other was living the third day after.

The uniformity of the reſults of theſe experiments upon the nerves induced me to think it quite ſuperfluous to repeat them; and, I am perſuaded, they will leave no doubt with any one who is accuſtomed to experiments, and not prejudiced in favour of ill grounded hypotheſes. Hence it follows, that the American poiſon is not poiſonous when applied to the nerves; and that in ſuch caſes it produces no ſenſible diſorder in the oeconomy of living animals: this is what the experiment directly eſtabliſhes. But to ſuppoſe what has not been obſerved; to believe what is contradicted by experiments is dreaming in philoſophy, running after error inſtead of truth, and adopting mere fancies for facts. The American poiſon (ſimilar in this reſpect to the poiſon of the viper) is not poiſonous, but quite innoxious, applied in any manner whatſoever, to the nerves. But it kills in a moment, and with the ſmalleſt quantity, when introduced immediately into the blood by the jugular, as does likewiſe the poiſon of the viper. Its action is therefore all upon the blood, and not in the leaſt upon the nerves, whatever may be the principle or the mechaniſm by which death is produced.

The effects and alterations cauſed in the blood by the poiſon of the viper are more determinate and more evident. Here a coagulation undeniably happens, which is not obſervable in the blood of animals killed by the American poiſon; but the latter produces a great change in the lungs, which are greatly diſordered by it.

It is true, that death happens ſo ſuddenly after introducing the American poiſon into the veſſels, that one cannot well comprehend how it can take place in ſo ſhort a time; for it may be ſaid, that the poiſon is hardly arrived at the heart before the animal is dead: nor is it well underſtood, how cold-blooded animals can be killed by it (frogs, for inſtance, which live ſo long with the circulation ſtopped) although it be true that they die much ſlower by theſe poiſons than other animals whoſe blood

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is warm. A humour, or the blood's being affected by a poiſon, may by degrees produce, in cold-blooded animals, diſorders ſtill greater than thoſe which may be cauſed by ſtopping the circulation.

By death taking place immediately on introducing the poiſon into the blood, we may be induced to ſuſpect, that there exiſts in that fluid a very active, ſubtle, and volatile principle, which eludes the acuteſt ſight, and even the microſcope itſelf. This principle may on this hypotheſis appear neceſſary to life, and againſt this principle the poiſon may be ſuppoſed chiefly to direct its operation.

That there really exiſts in the blood a very active and volatile principle, may very well be ſuſpected from ſeeing that the poiſon of the viper prevents the coagulation of the blood when it is drawn from the veſſels, whilſt, on the contrary, it produces a coagulation of it within the veſſels. It may be ſuppoſed, that ſomething evaporates from the blood when it is drawn out, which exiſts in it while within the veſſels. On this hypotheſis this active and vital principle may be conſidered as the reſult of the whole animal oeconomy, not excluding the nerves which may moſtly contribute to it. But all this is only mere conjecture, more or leſs probable, and unſupported by experiment. We ought to abide by ſure facts, let the mode of explaining them be what it may. Now theſe facts are, that the American poiſon does not act on the nerves, and that its action is intirely on the blood.

Before my experiments no perſon would have doubted but that the action of the American poiſon was immediately on the nerves. All the external ſigns declared it to be ſo. Theſe ſigns then are equivocal, and they are falſely adopted by phyſicians for the certain proofs that a diſeaſe is purely nervous. All theſe ſymptoms may exiſt without the nerves being in the leaſt affected: the alteration of the blood alone is ſufficient to produce them in a moment. The principal phyſicians have attributed the diſeaſe produced by the poiſon of the viper, and by the American poiſon, to an alteration in the nerves; it belongs to them now to examine, whether other diſeaſes, ſuppoſed generally to

be nervous, be not rather diſeaſes of the fluids, than diſeaſes of the blood. The ſuſpicion is great, the ſigns equivocal; the principle is ſhewn not to be general. I would not here aſſert, that no diſorder could ever be derived from the nerves; this would be running into one extreme in order to avoid another. There is no doubt but that many diſeaſes are nervous in their origin, and that many others become ſo from diſorders which have began in other parts, and thoſe merely fluid. The illneſſes which ariſe from mental uneaſineſs ſhew us the power of the nerves on living bodies. But all this does not prove that all the diſeaſes attributed to the nerves are nervous; and that the ordinary ſigns of this diſorder are not equivocal. And it is certain, that the poiſons we have examined have no immediate action on the nerves, as has been commonly believed hitherto. Some may object to this, that the poiſon of the viper and the American poiſon may act on the extremities of the nerves, and that for this reaſon they are innocent when applied to the trunk of the nerves. But this would be to object merely for the ſake of objection, and to fancy unneceſſary difficulties. The ſmalleſt variation of circumſtance would then be ſufficient grounds for objection; and who may not find a variety in things when it is ſo difficult to meet with two things alike? As for myſelf, I obſerve that the internal ſubſtance of the trunks of the nerves does not appear different from that which forms the extremities of thoſe nerves, that the trunk is ſubject to pain the ſame as the extremities, and that I am no inventor of hypotheſes which are not confirmed by facts.

In the univerſality of the conſequences which I have deduced from my experiments, I may be deceived; and I may even be deceived in ſome of the experiments themſelves, notwithſtanding that they have been very carefully conducted, and that I have ſought after truth without prejudice. I do not doubt, but that thoſe who may apply themſelves to ſuch reſearches after me, may find ſome things to add, and, perhaps, ſome to correct alſo. It is ſufficient for me to have opened a channel to new truths, and that the principal facts which I have advanced are true.

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The greateſt part of theſe experiments were made in the preſence of Dr. INGENHOUSZ, phyſician to the Emperor, my particular friend; a man who has manifeſted in ſeveral works his poſſeſſing the talents of a true obſerver. Mr. TIBERIUS CAVALLO was alſo preſent at many of the more important ones. I thought that the authority of two gentlemen, ſo well known to the learned, would procure the more credit to my experiments.

After having finiſhed my experiments on the American poiſon, a friend of mine in London procured me a great number of Eaſt Indian arrows. I wiſhed to make ſome experiments on them alſo; but thoſe I have made are neither many nor ſufficiently varied. It appears to me, however, that this poiſon differs not from the other, except in its being leſs active, in killing of animals: which leſſer activity is probably to be attributed either to theſe arrows having been leſs carefully preſerved than thoſe from the Weſt Indies, as really appeared to be the caſe, or elſe to the poiſons having been prepared many years ſince.

I have never ſucceeded in killing any rabbit (even the ſmalleſt-ſized one) with it, by applying it to the ſkin ſcratched or ſlightly wounded, although I have uſed it in greater quantities, and on more extenſive parts of the ſkin, than the poiſon of Ticunas; even in rabbits of ſcarcely a pound weight it did not produce any ſenſible alteration.

I pierced the ſkin of ſeveral animals with the arrows, and let them remain in it ſeveral whole days, without being able to perceive that the animal was affected with the poiſon; but when I perforated the muſcles with the arrows, and left them there, its effects were very obſervable. Several animals died in this manner, and that with all the viſible ſigns of the poiſon, and with all the ſigns or ſymptoms with which animals die who are killed by the American poiſon: it is true, however, that none of them died, or were ſenſibly affected, till after ſeveral hours; ſo that this poiſon ſeems not to differ eſſentially from the other. It perfectly agrees with it when examined with the microſcope, when mixed with turnſol, when thrown into the eyes of animals, when taſted with the tongue, and when chewed between the teeth;

teeth; on the other hand, it does not diſſolve ſo well in water as the other poiſon, for indeed a great part of it remains inſoluble in that fluid. The only conſequence which can be deduced from the facts above mentioned is, that the poiſon is much more noxious when applied to the muſcles than when applied to the ſkin, in which reſpect alſo it agrees very well with the other poiſons. This ſtill more convinces us, that the immediate action of theſe poiſons is not againſt the nerves, ſince it is certain, that the ſkin is more ſenſible than the muſcles, and that it is all interſected with nerves.

I have alſo made a few experiments on the oil of tobacco, the reſults of which I thought it might not be improper briefly to relate in this place.

Experiments made with oil of tobacco.

I made a ſmall inciſion in the right thigh of a pigeon, and applied to it one drop of the oil of tobacco, and in two minutes it loſt the uſe of the right foot.

I repeated the ſame experiment on another pigeon, with exactly the ſame effect.

I made a ſlight wound in the muſcles of the breaſt of a pigeon, and applied the oil of tobacco to it, and in three minutes the animal could not ſtand on its left foot.

And this ſame experiment was repeated on another pigeon, with the ſame ſucceſs.

Into the muſcles of the breaſt of a pigeon I introduced a tooth-pick ſteeped in the oil of tobacco, and a few ſeconds after the pigeon fell down ſeemingly dead.

Having applied the oil of tobacco to two other pigeons, they threw up ſeveral times all the food they had eaten.

Two others, treated in the ſame manner, but with empty ſtomachs, made many efforts to vomit.

In general, I found the vomiting to be a conſtant effect of this poiſon; but the loſs of motion in the part to which the poiſon is applied is only accidental.

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None of the animals, however, died by the application of the oil of tobacco.

Experiments with the water of the Lauro-Ceraſus.

I ſhall conclude my experiments on poiſons with an account of ſome that I have made on a poiſon which has for ſome years become remarkable in Europe. This poiſon is the water of the Lauro-Ceraſus, which is not inferior to any of the other very active poiſons, if conſidered with reſpect to the great diſorder which it introduces into the animal oeconomy, and the ſhort time which it takes to act when given to animals by the mouth. It not only produces the ſtrongeſt convulſions, and death itſelf, even in animals of a middle ſize; but, moreover, when it is given in ſmall doſes, the animal writhes ſo that the head joins the tail, and the vertebræ arch out in ſuch a manner as to fill every body who ſees it with horror. The convulſions and motions of the whole body are extremely violent, and the ſtruggles kill the animal in a ſhort time. If it be given to the animal as a gliſter, it equally produces the convulſions and death. With only two tea ſpoonfuls of the water given by the mouth, I have ſeen middle-ſized rabbits fall down convulſed in thirty ſeconds, and die within a minute. When it is given in great quantities to animals, they die almoſt in an inſtant, and without convulſions, the parts of the body being relaxed and pendent. When it is given in ſmall quantities, the convulſions are more or leſs ſtrong; the hind feet firſt loſe their motion, and afterwards the fore, which die ſlower. When the animal can no longer move its feet, or the reſt of the body, it ſtill moves very well the neck and the head, which it continues to hold up ſtrongly, and to turn round every way. In this ſtate the animal hears ſounds, and ſees objects; and although it has ceaſed to move its feet ſpontaneouſly, yet it ſtill moves them backwards and forwards when they are much pricked or ſqueezed; a ſign it can ſtill move them, though it moves them only on account of the great pain.

The water of the Lauro-Cerasus is, therefore, a strong poison when given by the mouth, or introduced into the body in the manner of a glister. Its action is so violent, and so quick, that it may be said to begin to act the moment an animal takes it into its mouth; certain it is, that it has scarce entered the stomach by the throat before the animal suffers. It is however true, that very small doses have no effect, that is, a little drop given to a small animal produces no sensible disorder, although the same quantity of the poison of Ticunas would be fatal. But that makes no essential difference between this poison and the other well known poisons.

I have found, that a certain quantity of water put on the leaves of the Lauro-Cerasus produces a liquor which is quite innocent, unless the leaves be in a great, and the water in a very small quantity. When the water is put several times on the same leaves, and drawn off successively, its activity becomes greater indeed, but still is not sufficient to take away life; but if, instead of a bare mixture with water, the infusion be distilled in balneo mariæ, the distilled liquor becomes then a most powerful poison, and proves fatal in a very short time. I have chiefly used it in this way, but I have no doubt but that it might be raised to such a degree of activity, as to prove mortal even when given in as small doses as the American poison. It might be sufficient to distil the liquor first obtained several times over again with new leaves well chopped and dried. I believe it would at last be obtained in the form of a concrete oily substance, which, evaporated by fire, would not only be equal in force to any known poison, but far exceed them all. But I reserve this experiment for some other occasion, when I shall also speak of the bitter almonds, and of the degree of poison to which their water can be raised by distilling it till it be dry.

The water of the Lauro-Cerasus kills animals when introduced into the cavity of the body; but what effect does it produce when applied to wounds? It may suffice here to relate one only of the various experiments which I have made. I opened the skin of the lower belly of a pretty large rabbit, and made a wound in it of about an inch long, and having slightly wounded

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the muſcles under it in many places, I applied to the part two or three tea-ſpoons full of the water: in leſs than three minutes the animal fell down convulſed, and died ſoon after. This experiment ſhews us, that the water of the Lauro-Ceraſus is a poiſon ſimilar to the others, and that it operates when inſinuated into the body by means of wounds made in it. This experiment has been attended with ſimilar reſults in other warm-blooded animals; but I have always found, that the water of the Lauro-Ceraſus, when given by the mouth, acts more powerfully and quicker than in the other way, even when the quantity given is ſmaller; a circumſtance, in my opinion, that deſerves the greateſt attention, ſince it is matter of fact, that a large wound offers many more veſſels to abſorb that poiſon immediately than the mouth and ſtomach; beſides that the nervous parts ought to be more affected from the very ſtate in which they are put by the wound. It is not the warm-blooded animals alone which are ſuddenly killed by this water when they are made to drink it, but the cold-blooded animals alſo die of the effects of it; and what appears to me very ſingular is, that they die in an extremely ſhort time, and perhaps more quickly than the others; which is quite contrary to what happens from the other poiſons. It may ſuffice for the preſent to mention eels, which are very difficult animals to kill, and ſtill continue to move their parts when dead. Theſe animals die in a few ſeconds after having drunk the water, and have ſcarcely ſwallowed it when they begin to contract themſelves; but death ſuddenly ſeizes them, and renders them immoveable in a moment, without leaving even the motion of the parts they uſually have on being handled. The heart, indeed, continues to beat, although faintly, but it ceaſes to move much ſooner than when they are killed by cutting off the head. Here it cannot be denied but that the muſcular irritability is extremely affected, and in a particular manner. I know not if there be any cold-blooded animal that reſiſts this poiſon. Thoſe which I tried it on all died; and I doubt whether there be any to which it is not fatal: if ſo, it deſerves a particular diſtinction, on account of its being the moſt terrible of all known poiſons, as well as for its univerſality in proving

fatal to all ſorts of animals. But how is it always mortal in ſo ſhort a time, when taken by the mouth, and admitted into the ſtomach, where we do not ſuppoſe there are any veſſels capable of receiving it? This difficulty requires ſome farther experiments. We ought to examine what effects it produces when applied immediately to the nerves, and when introduced into the blood without touching the parts which are cut.

For this purpoſe, I made uſe of large rabbits, and performed the experiments on their ſciatic nerves, in the ſame manner as I had done with the poiſon of the viper and the American poiſon. I ſhall here tranſcribe only one experiment, omitting the reſt for the ſake of brevity, not thinking them neceſſary after the great number which I have already related on the nerves.

Having detached the ſciatic nerve of a large rabbit for above an inch and a half, I introduced under it a wrapper of very fine linen, ſixteen times doubled, that the parts below it might not be penetrated by the water of the Lauro-Ceraſus. I then wounded the nerve with many ſtrokes of the lancet in the longitudinal direction, and covered all this wounded part, which extended above eight lines in length, with a roll of cotton of three lines in thickneſs, well ſteeped in the laurel water. More than fifteen drops of the water were wanted to moiſten the cotton, and this water communicated itſelf directly by the wounds to the medullary ſubſtance of the ſciatic nerve. I covered the whole about a minute after with new rags, ſo that it was impoſſible for the Laurel water to communicate with the parts below it or near it. Having ſewed up the external ſkin, and left the animal at liberty, it ſeemed not to be in the leaſt affected, neither then nor afterwards. It ran about, and eat, and was as lively as ever. In ſhort, the animal was not ſenſibly affected in this way by this poiſon, which kills ſo quickly when it is taken in by the mouth. This caſe, as well as many others, is very ſimilar to thoſe of the poiſon of the viper and of the American poiſon; and it ſhews, that the water of the Lauro-Ceraſus applied immediately upon the nerves, and ſo inſinuated into the medullary ſubſtance of them, is not at all poiſonous; conſequently, that it does not act upon the nerves, however applied externally.

After ſo many experiments) as have been related in the courſe of this eſſay) on the poiſon of the viper, and on the American poiſon, a ſtill more powerful one than the former; and after having ſeen that neither of theſe two poiſons act on the nerves, when applied immediately to them, while they inſtantly kill very ſtrong animals when introduced into the blood; nothing was more natural than to conclude, that the poiſon of the Lauro-Ceraſus, which is equally innocent with the others when applied to the nerves, would alſo prove mortal when introduced into the blood: experience, however, ſhews quite the contrary; ſo true is it that we ought to miſtruſt analogy, even when it appears moſt uniform. I introduced the water of the Lauro-Ceraſus into the jugulars of a large rabbit, to the amount of five drops or upwards, in the ſame manner as I had done the poiſon of the viper and the American poiſon, yet the animal ſhewed no ſigns of ſuffering. I ſuſpected I had not performed the operation right; that I had not introduced any of the water into the veſſels; and that the ſyringe had inſinuated itſelf into the cellular membrane. I therefore repeated the experiment, and again introduced into the jugular a quantity of poiſon, perhaps three or four times greater, and I was very careful to make the point of the ſyringe enter the jugular properly before I introduced the poiſon, that the poiſon ſhould not by any means turn back again; yet ſtill the animal was not affected by it, but continued as lively as ever. I was more ſurprized than ſatisfied with all this. I could not perſuade myſelf, that the water of the Lauro-Ceraſus was not a poiſon, and a very powerful one too, when introduced into the blood, ſince it was poiſonous when applied to wounds in the fleſh, and taken by the mouth, and likewiſe inactive and harmleſs when applied to the nerves. I therefore again repeated the experiment, and this time I introduced by the jugular a whole tea-ſpoonful of the Laurel water; and yet ſtill the animal was not affected. I alſo tried the ſame experiment on another rabbit, into the jugulars of which I introduced a large tea-ſpoonful of the ſame poiſon; yet neither did this rabbit ſhew any ſigns of ſuffering, either then or afterwards.

The unexpected reſult of theſe experiments threw me into a very great uncertainty concerning the action of this poiſon: I could neither comprehend the mode of its operation, nor even upon what parts it acted when taken by the mouth or applied to wounds. Here all was confuſion: it was found neither to act on the nerves nor on the blood, and yet it killed, and that in an inſtant, when introduced into the ſtomach by the mouth.

Is there then a new way of deſtroying the life of animals different from that of the blood and of the nerves? The loſs of motion, and that too in a few ſeconds, in ſuch animals as eels, which in other caſes continue to move for hours after the head is cut off, and even after they are cut in pieces, would make one believe, that the irritability of the muſcular fibres was affected by this poiſon. It is true, indeed, that the heart continues to move in thoſe animals; but that motion is very much leſſened, and laſts but for a very ſhort time. In the warm-blooded animals, juſt killed by this poiſon, there ſtill exiſts ſome motion, but it is very little; and although their heart continues to beat for ſome time, it beats much leſs than when they are killed by other means. The irritability is certainly diminiſhed very much in many animals, and in many others intirely deſtroyed; by whatever means the poiſon kills in ſo ſhort a time, and however obſcure the mechaniſm may be by which the muſcular fibres loſe their irritability. We muſt confeſs our ignorance in our reſearches into nature. When we think we have accompliſhed every thing, we ſuddenly find ourſelves juſt where we began. Experiment is the only guide which we have to conduct us in our reſearches: experiment is indeed a ſecure way of avoiding error, but experiment does not always leads us to the more remote truths, nor always guide us to the knowledge of the ſecret arcana of nature, nor yet always conduct us whither we have propoſed to go.

But although we know not how the Laurel water operates, or, more properly ſpeaking, on what part that poiſon exerts its action, when it kills animals, we know, however, that it is quite innocent when applied immediately to the nerves, and even to their medullary ſubſtance: and it is equally true, that all the experiments above related clearly ſhew, that the poiſon of the viper

viper and the American poiſon are both harmleſs any how applied to the nerves; but that they are both poiſonous when introduced into the blood. Theſe are facts which were before unknown; they are truths now laid open; nor can they be brought into doubt again by any one. Theſe facts deſtroy all the ſyſtems that have been invented by the writers upon the action of thoſe poiſons; and from theſe facts we ought to ſet out to arrive at the knowledge of thoſe poiſons, and of the manner in which they operate.

Some light might probably have been thrown upon the action of the poiſon of the Lauro-Ceraſus, by applying it to different parts of the brain of living animals; but I reſerve this experiment for a more convenient occaſion than the preſent, and till I ſhall have reduced the Laurel water to the conſiſtence of ſyrup. In that ſtate, the poiſon being rendered much more active, will probably offer new and more important facts, and may perhaps give a clearer inſight into its operation; as alſo enable us to judge upon what parts of living animals it acts ſo as to kill them. I ſhall alſo reſerve for that time the trial of whether that poiſon acts upon the lymphatic veſſels, or, to ſpeak more properly, on the lymph itſelf. This is a mere ſuſpicion which I have lately taken up, and which my preſent circumſtances do not permit me to examine at preſent. I am therefore forced to give my experiments on this ſubject, in ſome meaſure, defective and unconnected.